

◆ PRECISION INSTRUMENTS FOR TEST AND MEASUREMENT ◆

PRS-330 SERIES

Programmable Decade Resistance Substituter (IEEE-488.2, Ethernet and USB) Operation Manual



IET LABS, INC.

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PRS-330 IM / February 2023



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WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable IET specifications. If within one year after original shipment, it is found not to meet this standard, it will be repaired or, at the option of IET, replaced at no charge when returned to IET. Changes in this product not approved by IET or application of voltages or currents greater than those allowed by the specifications shall void this warranty. IET shall not be liable for any indirect, special, or consequential damages, even if notice has been given to the possibility of such damages.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

Revision History

Revision	Description
March 2019	Initial release
January 2021	new command SYSTEM:HIGHSPEED
January 19, 2023	Modified 8.1.3 for better clarification on resistance values
February 7, 2023	Modified 8.1.3 to match version 1.27 Firmware

SAFETY PRECAUTIONS

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS elsewhere in this manual may impair the protection provided by the equipment. Such noncompliance would also violate safety standards of design, manufacture, and intended use of the instrument.

IET Labs assumes no liability for the customer's failure to comply with these precautions.

The PRS-330 complies with INSTALLATION CATEGORY I as well as POLLUTION DEGREE 2 in IEC61010-1.

If an instrument is marked CAT I (IEC Measurement Category I), or it is not marked with a measurement category, its measurement terminals must not be connected to line-voltage mains.

The PRS-330 is an indoor use product.



DANGEROUS PROCEDURE WARNINGS



Comply with all WARNINGS - Procedures throughout in this manual and instructions on the instrument prevent you from potential hazard. These instructions contained in the warnings must be followed.

BEFORE APPLYING POWER

Verify that all safety precautions are taken. Make all connections to the instrument before applying power. Note the instrument's external markings described under "Safety Symbols".

GROUND THE INSTRUMENT

This is a Safety Class I instrument. To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The power terminal and the power cable must meet International Electrotechnical Commission (IEC) safety standards.

SAFETY PRECAUTIONS CONTINUED



- DO NOT Operate in an Explosive Atmosphere
- Do not operate the instrument in the presence of inflammable gasses or fumes
- Operation of any electrical instrument in such an environment clearly constitutes a safety hazard
- Use Caution around live circuits and whenever hazardous voltages > 45 V are present
- Operators must not remove instrument covers
- Component replacement and internal adjustments must be made by qualified maintenance personnel only
- DO NOT substitute parts or modify the instrument
- When working with high voltages; post warning signs, train personnel and keep unauthorized personnel away.

Do not apply any voltage or currents to the terminals of the instrument in excess of the maximum limits indicated in the specifications section of this manual.

To avoid the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument.

Return the instrument to an IET Labs for service and repair to ensure that safety features are maintained in operational condition.

Safety Symbols

General definitions of safety symbols used on the instrument or in manuals are listed below.



Caution symbol: the product is marked with this symbol when it is necessary for the user to refer to the instruction manual.



Hazardous voltage symbol: the product is marked with this symbol when high voltage maybe present on the product and an electrical shock hazard can exist.



Indicates the grounding protect terminal, which is used to prevent electric shock from the leakage on chassis. The ground terminal must connect to earth before using the product



Direct current.



Alternating current.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.



On supply.



Off supply.



Hot surface. Avoid contact. Surfaces are hot and may cause personal injury if touched.

Disposal



Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This product complies with the WEEE Directive (2002/96/EC) marking requirements.

The affixed label indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.

Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities.

Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being.

When replacing old appliances with new one, the retailer is legally obligated to take back your old appliances for disposal.

Proposition 65 Warning for California Residents



WARNING: Cancer and Reproductive Harm - www.P65Warnings.ca.gov.

This product may contain chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm

CONTENTS

WARRANTY	i
WARNING	ii
CAUTION	ii
CONTENTS	iii
Chapter 1: INTRODUCTION	1
Chapter 2: SPECIFICATIONS	3
2.1 Specifications	3
2.2 General Specifications and Stability	4
2.2 Typical Label.....	5
Chapter 3: OPERATION	7
3.1 Initial inspection and setup	7
3.1.1 Purpose	7
3.1.2 Storage.....	7
3.1.3 Bench and Rack Setup.....	7
3.1.4 Front and Rear Panel	7
3.1.5 Power Connections.....	8
3.1.6 Environmental	8
3.1.7 Safety Considerations.....	8
3.1.8 Cleaning.....	9
3.2 Connection.....	9
3.2.1 General Considerations	9
3.2.2 Electrical Considerations.....	9
3.3 Condensed Operating Instructions.....	10
3.4 Menu Structure.....	11
3.4.1 Home Screen	15
3.4.2 Setting a Resistance Value.....	15
3.4.3 Menu Key.....	15
3.4.4 Resistance Settings Menu.....	15
3.4.5 Standard Values Menu.....	16
3.4.5.1 Set Values	16
3.4.5.2 Standard Value.....	17
3.4.5.3 Decade Value.....	17
3.4.5.4 Percent Value.....	17
3.4.6 RTD and Other Tables Menu.....	18
3.4.6.1 User Select RTD Menu	19
3.4.7 Remote Communications Settings Menu	19
3.4.7.1 IEEE Interface Menu.....	20
3.4.7.2 Ethernet Interface Menu.....	20
3.4.8 About Menu.....	20
3.5 Thermal emf Considerations	21
3.6 Environmental Conditions.....	21

3.7 Remote Operation.....	21
Chapter 4: USB Interface	22
4.1 Introduction.....	22
4.2 Capabilities	22
4.3 USB Operation.....	22
4.3.1 USB Interface Drivers	22
Chapter 5: ETHERNET INTERFACE	23
5.1 Ethernet Programming.....	23
5.2 Network Setup	23
5.3 Ethernet Test Keyboard.....	23
5.4 Network Configuration	24
5.5 Web Browser Configuration.....	25
5.6 VXI Configuration Utility	26
5.7 Resetting Default Network Settings.....	28
Chapter 6: IEEE INTERFACE.....	29
6.1 Introduction.....	29
6.2 Capabilities	29
6.3 Address Switch and Communications Settings.....	29
6.4 IEEE Option Operation.....	29
Chapter 7: PROGRAMMING.....	31
7.1 Introduction	31
Chapter 8: MAINTENANCE	33
8.1 Verification of Performance	33
8.1.1 Calibration Interval.....	33
8.1.2 General Considerations	33
8.1.3 Calibration Procedure	33
8.1.4 Adjustment of Internal Resistors	34
8.1.5 Calibration Menu and Process.....	35
8.1.6 Full Calibration (adjustment).....	35
8.1.7 Calibration History	36
8.2 Replaceable Parts List.....	35
Chapter 9: PRS-DMM Self Adjusting Software	39
9.1 PRS-DMM Self Adjusting Software	39
9.1.1 Overview	39
9.1.2 General Requirements.....	39
9.1.3 Software Installation	39
9.1.4 Connection Between DMM and PRS-330	39

9.1.5 PC Connection Between DMM and PRS-330.....	40
9.2 PRS-DMM Main Screen	40
9.2.1 PRS-DMM Main Screen Operation.....	40
9.3 PRS-DMM Settings	40
9.3.1 PRS-DMM Settings Screen	40
9.3.2 PRS Settings	40
9.3.3 Meter Settings	41
9.3.4 Adjust PRS	42
9.3.5 PRS-DMM Speed.....	42
APPENDIX A: SCPI COMMAND REFERENCE.....	44
APPENDIX B: IEEE.2 COMMON COMMANDS	47

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Chapter 1

INTRODUCTION

The PRS-330 (Figure 1.1) is a high precision manual and programmable decade substituter. The PRS-330 series provide direct resistance substitution as well as RTD (Resistance Temperature Detector) simulation.

The PRS-330 substituter is a precision resistance source with excellent characteristics of stability, temperature coefficient, and power coefficient. These features combined with a low virtually constant “zero resistance” make for very versatile instruments.

Operation is both local using convenient touch screen, keypad and standard USB, Ethernet, and IEEE-488.2 interfaces.

The PRS-330 employs very low resistance, low thermal emf relays with gold-clad silver-alloy contacts. A special design keeps contact resistance to a minimum. The gold plating keeps the silver contacts from becoming tarnished when unused, or when only low currents are passed through them. This is most often the case when only minute test currents are drawn by digital multimeters and other test instruments. Contact resistance remains low and repeatable.

High-quality gold-plated tellurium-copper five-way binding posts serve to minimize the thermal emf effects, which would produce errors in dc resistance measurements.

With a resolution as low as 1 $\mu\Omega$ and a

maximum available resistance of 20 M Ω , the PRS-330 may be used for exacting precision measurement applications requiring high accuracy, good stability, and low zero resistance.

The PRS-330 is suited for automatic and manual calibration and testing, simulation of RTD’s, programmable loads, and many other laboratory and industrial applications.

The PRS Series may be rack mounted to serve as components in measurement and control systems.

The PRS-330 (Figure 1.1) is part of the PRS family of high precision manual and programmable decade substituters. This series offers a wide choice of ranges, power, voltage, and accuracies for a wide variety of design and production applications.

The PRS-330 uses a microcontroller design to enhance the ease of use and calibration. It provides



Figure 1.1: High Precision Programmable Decade Resistance Substituter

direct resistance substitution as well as RTD (Resistance Temperature Detector) simulation. It allows for higher precision and tight tolerances.

The PRS-330 is a precision resistance source with excellent characteristics of accuracy, stability, temperature coefficient, and power coefficient. It is direct reading without the need to subtract “zero resistance.”

The PRS-330 offers the option of true 4-wire Kelvin measurement for calibration applications and 2-wire mode for use in series as a substitute resistor and for RTD applications. The front panel display indicates the mode selected: 2-wire or 4-wire.

There are 4 pre-programmed RTD resistance tables, and others may be added by the user. The controller allows for other convenient programmed features.

The unique design makes adjustment of the PRS-330 for calibration semiautomatic. An internal calibration routine guides the user to perform measurements using only a precision ohmmeter and enter the measured values into the PRS-330. No other standards are required.

IET Labs offers the PRS-DMM Self Adjusting Software which works with the PRS-330 and

Fluke 8508A or Keysight 3458A to automate this adjustment process and eliminate the need for a technician to manual enter the resistance values manually into the PRS-330 See Chapter 9 for more information

Chapter 2 SPECIFICATIONS

For convenience to the user, the pertinent specifications are given in an OPERATING GUIDE, shown typically in Figure 2.1, affixed to the case of the instrument.

2.1 Specifications

User interface:

Numeric keypad, softkeys and color capacitive touch screen

Accuracy:

±(70 ppm + 1 mΩ) 2 and 4 Terminal at 23°C ±5°C

Minimum setting: 0.100 000 Ω

Resolution: 1 μΩ or 6 digits

Range: 0.1 Ω - 20 MΩ

Stability: ±50 ppm/year

Thermal emf: <15 μV

Resistance difference front to rear binding posts:

±(2 ppm + 20 μΩ)

Maximum load: 2 A, 200 V (peak), 0.5 W whichever applies first

Resistors: Precision wire-wound and metal foil

TC of resistors: <1 ppm/°C for 1.37 Ω and above

Relays¹: Silver Alloy contacts, expected life of 10⁸ cycles

Switching time: <100 ms second per change (SYSTEM:HIGHSPEED enabled)

RTD simulation:

9 RTD tables can be entered into memory to allow user selection of temperature and the correct value of resistance will automatically be programmed.

PT-100 and PT-1000 tables for both Fahrenheit and Celsius are pre-programmed into memory locations 1 to 4.

Adjustment:

Automatic adjustment procedure utilizing a high precision DMM eliminates the requirement for manual

trimming of resistors.

Terminals:

Front and rear connections each consisting of 4 low-emf, gold-plated, tellurium-copper 5-way binding posts are used for **HI** and **LO** terminal pairs for **CURRENT** and **SENSE**. **GND** binding post is connected to the case, to chassis ground.

ac frequency response:

Residual capacitance terminals to GND: < 850 pF

Resistance	Typical ac/dc difference @ 1 kHz
0.1 Ω -10 kΩ	<100 ppm
10 - 100 kΩ	<200 ppm
100 kΩ - 1 MΩ	<1%
1 - 20 MΩ	<20%

Power requirements:

90 - 264 Vac , 47 - 63 Hz., 30 W. Max.

Fuse: T 0.8 A, 250 V, 5 x 20 mm

Environmental conditions:

Operating: 10°C to 40°C;

<80% RH non-condensing

Storage: -40°C to 70°C; <90% RH non-condensing

Remote control:

USB: USB Type B connector standard on rear panel; uses standard MCP2200 chip set

GPIO:

GPIO standard 24 pin connector, conforms to IEEE-488.2; SCPI 1994.0 command set; Hardware or software configurable addressing range of 1 to 30.

Ethernet:

IEEE 802.3 compliant, Speeds 10 BaseT (10 Mb/s) and 100 BaseT (100 Mb/s), IP Address Static or DHCP, Factory setting 192.168.0.254 static

Dimensions:

Bench model: 43 cm W x 8.9 cm H x 33 cm D (17" x 3.5" x 13") in front of panel: 3.8 cm (1.5")

Rack Mount: 47 cm W x 8.9 cm H x 33 cm D (19" x 3.5" x 13") in front of panel: 3.8 cm (1.5")

Weight:

Bench model: 5.5 kg (12 lb) nominal

¹ Note: Warranty covers relays up to expected life

2.2 General Specifications and Stability

Warm-up:

This unit utilizes custom designed low thermal emf relays for high stability and low-level signal applications. This thermal voltage is nominally less than 15 μV under laboratory conditions. Please note that a change in this thermal emf will give a false drift in resistance as measured by a dc ohmmeter, since the ohmmeter will interpret this emf as an effective resistance. The worst case such effective drift after warm-up is less than ± 25 ppm, primarily due to stabilization of this emf at the relay contacts as settings are changed.

Unit should be allowed to stabilize for one hour. For maximum stability, allow unit to warm-up over two hours.

Recommended Calibration Interval:

Typical calibration interval 12 months. Adjustment can easily and automatically be accomplished using IET's PRS-DMM software. Adjusting the PRS-330 can improve accuracy associated with the drift of the resistors.

Environmental:



This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control instrumentation" product.

Effects of Humidity:

Exposure to humidity $> 60\%$ for a periods of weeks can cause the resistors to drift some of that is reversible. It is recommended that the PRS-330 be stored at humidities less than 50% to minimize this.

Short-term Stability:

The PRS-330 was tested for extended periods of time. Based upon this testing the following stability information was determined. These specifications apply for the PRS-330 in 4 terminal mode with shorting links removed and without switching to another value.

Typical short-term stability without switching:

$< \pm(4 \text{ ppm} + 100 \mu\Omega) / 10 \text{ minutes}$

Typical 24 hr. Accuracy after Adjustment:

After performing an adjustment per 8.1.4 of this manual using a Fluke 8508A and then performing a calibration verification per 8.1.3 within 24 hours the typical accuracy is:

$\pm(30 \text{ ppm} + 300 \mu\Omega)$ for values $< 1 \text{ M}\Omega$
 $\pm 60 \text{ ppm}$ for values $> 1 \text{ M}\Omega$

See graph below for actual performance, shown in blue, with 6 digit resolution across resistance range. The red lines represent tolerance of $\pm(30 \text{ ppm} + 300 \mu\Omega)$.

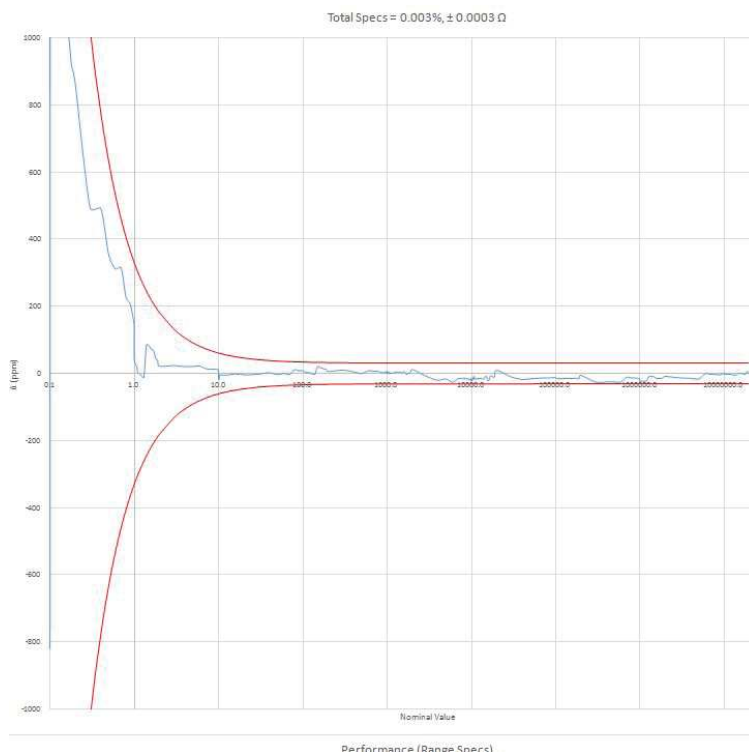


Figure 2-1 Error versus Resistance up to 1 MΩ

PRS-330 PROGRAMMABLE DECADE RESISTANCE SUBSTITUTER

CONSULT INSTRUCTION MANUAL FOR PROPER INSTRUMENT OPERATION

Accuracy: $\pm(0.007\% + 1 \text{ m}\Omega)$ 2 and 4 Terminal at 23°C $\pm 5^\circ\text{C}$

Minimum setting: 0.100 000 Ω

Resolution: 1 $\mu\Omega$ or 6 digits

Stability: ± 50 ppm/year

Range: 0.1 Ω - 20 M Ω

Thermal emf: $<15 \mu\text{V}$

Maximum Load: 2 A, 200 V (peak), 0.5 W whichever applies first

Resistors: Precision wire-wound and metal foil

RTD Tables:
 PT-100 and PT-1000 tables for both Fahrenheit and Celsius are programmed into memory locations.
 9 RTD tables can be entered into memory to allow user selection of temperature and the correct value of resistance will automatically be programmed.

Adjustment:
 Automatic adjustment procedure utilizing a high precision DMM eliminates the requirement for manual trimming of resistors.

Relays¹: Silver Alloy contacts, expected life of 10^8 cycles

Terminals:
 Four low-emf, gold-plated, tellurium-copper 5-way binding posts are used for **HI** and **LO** terminal pairs for **CURRENT** and **SENSE**. **GND** binding post is connected to the case, to the chassis ground and to the earth ground.

Switching time: <100 ms per change (SYSTEM:HIGHSPEED enabled)

Power requirements:
 90 - 264 Vac , 47 - 63 Hz. 30 W. Max.

Remote Control:
USB: Standard USB Type B connector on rear panel, uses MCP2200 driver

Remote Control Options:
IEEE: GPIB standard 24 pin connector, conforms to IEEE-488.2; SCPI 1994.0 command set; Hardware or software configurable addressing range of 1 to 30.
Ethernet: IEEE 802.3 compliant, Speeds 10 BaseT (10 Mb/s) and 100 BaseT (100 Mb/s), IP Address Static or DHCP, Factory setting 192.168.0.254 static

¹Note: Warranty covers relays up to expected life

MODEL: PRS-330

SN: B2-18431158

WARNING

Observe all safety rules when working with high voltages or line voltages. Connect the (GND) terminal to earth ground in order to maintain the case at a safe voltage. Whenever hazardous voltages (>45 V) are used, take all measures to avoid accidental contact with any live components: a) Use maximum insulation and minimize the use of bare conductors. b) Remove power when adjusting switches. c) Post warning signs and keep personnel safely away.



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PRS-330 Nov. 2018

*FIGURE 2.1 Typical OPERATING GUIDE Affixed to Unit
 (Please see label affixed to your unit)*

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Chapter 3 OPERATION

3.1 Initial inspection and setup

This instrument was tested and carefully inspected before shipment. It should be in proper electrical and mechanical order upon receipt.

An **OPERATING GUIDE** is attached to the case of the instrument to provide ready reference to specifications.

3.1.2 Purpose

The purpose of the PRS-330 is to source resistance in the range of 0.1 Ω to 20 M Ω for calibration of DMMs, meters and use as an RTD Simulator.

3.1.3 Storage

If this instrument is to be stored for any lengthy period of time, it should be sealed in plastic and stored in a dry location. It should not be subjected to temperature extremes beyond the specifications. Extended exposure to such temperatures can result in an irreversible change in resistance, and require recalibration.

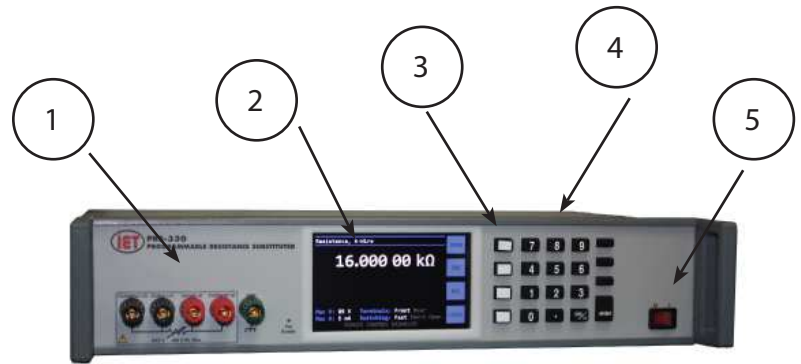
3.1.4 Bench and Rack Setup

The PRS-330 should be placed on a stable flat work surface. A front bail is provide to make viewing easier.

Mount the unit in a standard 19" rack if the rack mount option is specified.

3.1.5 Front and Rear Panel

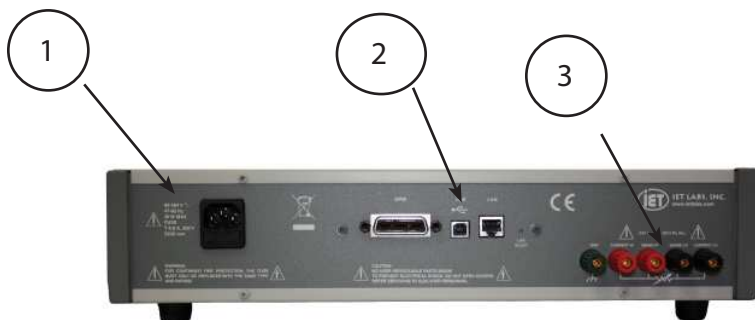
The front panel has a capacitive touchscreen, front binding posts, softkeys, numeric keypad and power switch.



Front Panel

Model Ref.	Description
1	Front Binding Posts
2	Capacitive Touchscreen
3	Softkeys
4	Numeric Keypad
5	Power Switch

The rear panel has an IEC inlet module for connection to mains power, GPIB, USB and Ethernet interfaces and rear binding posts.



Rear Panel

Model Ref.	Description
1	IET Inlet Module
2	GPIB, USB and LAN Interfaces
3	Rear Binding Posts



3.1.6 Power Connections

Power connection to the rear panel is through an ac inlet module comprised of an ac connector and fuse drawer.

Always use an power cord and outlet that has a properly connected protection ground to avoid shock. The PRS-330 is provided with a 3-prong power cord with ground.

Plug the supplied IEC power cord into the instrument into a power receptacle that has a ground. The power cord may of course be selected to match the available receptacle.

Confirm that the power supplied to the PRS-330 meets the following requirements

Power requirements:

90 - 264 Vac , 47 - 63 Hz., 30 W. Max.



Fuse

Only replace fuse with the same type and rating.

UL/CSA type, T 0.8 A,250 V, 5 x 20 mm



3.1.7 Environmental

Do not operate the instrument in the presence of flammable gasses or fumes.

The PRS-330 is for indoor use only.

To ensure that the safety requirements, the specifications, and the measurement accuracy of the PRS-330 are met, you must maintain the environmental temperature to within the specified range by providing an appropriate cooling clearance around the PRS-330 or, for the rack-mounted type, by forcefully air-cooling inside the rack housing, if necessary.



Temperature and Humidity

Operating: 10°C to 40°C; <80% RH non-condensing
Storage: -40°C to 70°C ; <90% RH non-condensing

Altitude

Operating: 0 - 2000 m; storage: 0 - 4600 m



3.1.8 Safety Considerations

Refer to the Safety Summary page at the beginning of this guide for general safety information. Before installation or operation, review this guide for safety warnings and instructions. Safety warnings for specific procedures are located at appropriate places throughout this

guide.

There are no user serviceable parts inside the PRS-330. Servicing should be referred to qualified personnel.

3.1.9 Cleaning

To prevent shock unplug the PRS-330 from mains prior to cleaning.

Use a dry cloth or a cloth slightly dampened with water to clean the external case parts.

Do not use detergents or chemical solvents.

Do not attempt to clean internally.

Denatured alcohol can be used to clean insulators around binding posts.

3.2 Connection

3.2.1 General Considerations

The PRS-330 Programmable Decade Resistance Substituter utilizes a 5-terminal connection. The binding posts are standard laboratory type and readily accept banana plugs, spade lugs, alligator clips, and bare wire. Binding posts are located on the front panel and rear panel of the instrument.

The Kelvin terminals consisting of a **CURRENT** and a **SENSE** pair, each labeled **HI** and **LO**. These minimize contact resistance.

4 Wire connection

The gold shorting links must be removed on the binding posts of the PRS-330 when set to 4 Wire.

2 Wire connection

The gold shorting links must be used on the

binding posts of the PRS-330 when set to 2 Wire. See section 3.4.4 for more information

The **GND** terminal on all models is connected to the case and to earth and chassis grounds. This may be used as a shield terminal.

3.2.2 Electrical Considerations

The performance of the PRS-330 is directly affected by the quality of the connection to the system under test. This is particularly true with the precision series models having higher-accuracy and/or lower-impedance decades.

For optimum performance, contact resistance should be kept to a minimum by using the most substantial mating connection possible, and by assuring that the connection is well secured to the binding posts.

3.3 Condensed Operating Instructions

1. Turn on the PRS-330 ON using POWER SWITCH
2. From the Home screen, select a desired resistance value in one of the following ways:
 - a) Enter a value using the number keys, then press **ENTER**.
 - b) Press the resistance value shown on the touch screen and then enter the resistance value using the touch screen or keypad.
3. The source resistance will be output to the front or rear binding posts and is indicated at on the bottom half of the Home screen. Front and rear binding posts can be selected by going to Main Menu>Resistance Settings.
4. 2-Wire or 4-Wire connection mode is shown at the top of the Home screen. This can be changed by going to Main Menu>Resistance Settings.

3.4 Menu Structure

The tables on the next few pages shows the menu structure of the PRS-330.

Menu items with a “:” allow selection of a value or feature when **ENTER** pressed. Menu items without “:” have a submenu with more than 1 item.

Press **MENU** to display **Main Menu** and press the **Back** key to return to **Home** screen.

Below is the basic menu structure of the PRS-330.

3.2 Connection

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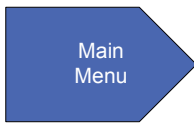
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Press **MENU** to display **Main Menu** and press the **Back** key to return to **Home** screen.

Below is the basic menu structure of the PRS-330.

PRS-330



Resistance Settings
Remote Communication Settings
Instrument Calibration (only shown when Cal Enable pressed)
About



Connection Mode: 4-Wire or 2 Wire
Terminal Selection: Front or Rear
Standard Values
RTD and Other Tables Settings
Switch Mode: Fast or Slow



*Set Value: 0.1 Ω
Standard Value: 1%
Decade Value: 0.1 Ω
Percent Value: 0.001%



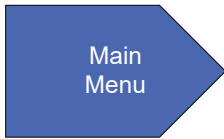
*Probe Type: None, PT-100 °C, PT-100 °F, PT-1000 °C, PT-1000 °F, or Default
User Selected RTD



User Function: Default
Units: °F, °C, K

Main Menu>Resistance Settings

PRS-330



Resistance Settings
Remote Communication Settings
Instrument Calibration (only shown when Cal Enable pressed)
About



IEEE
Ethernet



IEEE Address: 1 - 30



IP Address: 192.168.100.101
Network Gateway: 192.168.100.1
Network Mask: 255.255.255.0
Mac Address: 00:00:00:00:00:00

Main Menu>Remote Settings



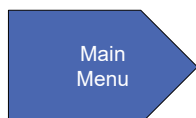
Full Calibration <Enter Password>
Trace Calibration <Enter Password>
Calibration History



Calibrated Resistor: <R1 – R43>

Main Menu>Calibration

PRS-330



Resistance Settings
Remote Communication Settings
Instrument Calibration (only shown when Cal Enable pressed)
About



IET Labs, Inc.
PRS-330
SN: XX-XXXXXXXX
FW: 1.15
HW: 1.00
Reset to Default <Yes or No>
Factory Reset <Yes or No>

Main Menu>About

3.4.1 Home Screen

The home screen shows the resistance value in ohms or temperature if RTD tables are used. The main display also shows if the unit is configured for 4-wire mode or 2-wire mode in the upper left corner of the display after **Resistance**.



Figure 3-1 Home screen showing 2-Wire

See section 3.2.1 for more information on 2-wire and 4-wire connections.

Pressing **MENU** will display the main menu. Pressing **INC** or **DEC** will increment or decrement the resistance value based upon Resistance Settings>Standard Values. This allows increasing or decreasing the resistance value by a percentage, value in Ωs decade value or EIA preferred values.

Pressing the **LOCAL** key will switch from Remote control to local control.

The bottom part of the home screen shows relevant setup information. These settings can be changed in the Resistance Settings menu.

3.4.2 Setting a Resistance Value

To set a resistance value use the numeric keypad to enter the value followed by the **ENTER** key. Pressing the resistance or temperature value shown on the Home screen will also allow entry

of the value via the touch screen. During entry you can use softkeys to select **Ω**, **kΩ** or **MΩ**.

3.4.3 Menu Key

Pressing the **MENU** key will show the MAIN menu screen. See Figure 3-2.



Figure 3-2 Menu Screen

Use the **↑** key to move UP and the **↓** to move DOWN within the items shown on screen.

Press the **ENTER** key to change the item's value or go to the next menu.

Press the **BACK** key to return to previous MENU or home screen at anytime.

3.4.4 Resistance Settings Menu

Using the UP and DOWN arrow keys **RESISTANCE SETTINGS** can be highlighted in yellow, press the **ENTER** key to go to the **RESISTANCE SETTINGS** menu.

Breadcrumb navigation shown at the top of the screen shows exactly where you are in the menu system.

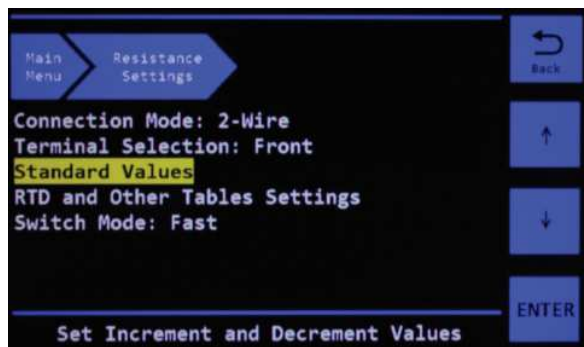


Figure 3-3 Resistance Settings Menu

There are 5 selections available in the **RESISTANCE SETTINGS** menu.

Highlight the selection and press **ENTER** to change the selection.

Connection Mode: allows the user to change between 2-Wire and 4-Wire connections.

In 2-Wire the shorting links should be connected between the two LO terminals, and between the two HI terminals.

In 2-Wire mode the internal trace resistance inside the PRS-330 is automatically compensated for, so no zero subtraction is required.

In 4-Wire mode shorting links should be removed from the binding posts. This mode was designed to be used with DMMs, other meters with 4 terminal (Kelvin connections) and temperature controllers and indicator using 4 terminal RTDs.

Terminal Selection: allows selection of either rear binding posts or front binding posts to be connected to the source resistance.

There is no significant difference in accuracy

Switch Mode: Allows selection of Default, Open or Short modes. When the resistance or temperature value is changed via the front panel or when a SOURCE:DATA command is sent via the remote interfaces, the intermediate value

between previous value and the new value will either be a SHORT, OPEN or undetermined in default switching case.

Standard Values and RTD and Other Tables Settings have separate menus which are described in the sections below.

3.4.5 Standard Values Menu

There are 4 selections available in the **STANDARD VALUES** menu. The **STANDARD VALUES** menu is only applicable to resistance values and not RTD or Tables.

The selection of the standard values controls how the **INC** and **DEC** softkeys work on the **Home** screen see Figure 3-1.

When a value is entered into one of the 4 selections such as Percent Value: shown in Figure 3-4 the **INC** and **DEC** keys will then in this example increment or decrement the resistance value by 10% each time the key is pressed. An * before the selection indicates which is active. The last selection to which a value was entered becomes the active selection.

3.4.5.1 Set Values

The **Set Value:** selection allows the resistance value to be changed by a specific value in Ω s each time the **INC**, increment, and **DEC**, decrement, key is pressed.

Highlight **Set Value:** and press **ENTER** to change the set value.

When a **Set Value:** is selected on the PRS-330 pressing the **INC** and **DEC** softkeys will increment the resistance value to the next resistance value plus or minus the **Set Value**.

3.4.5.2 Standard Value

The **Standard Value:** allows the PRS-330 to be used as an automated resistance carousel with built-in EIA “preferred value” resistance tables of 1% (E96), 5% (E24), 10% (E12) increments or RATIO-METRIC user specified increment.

0.8% but can be set to the required value in %.

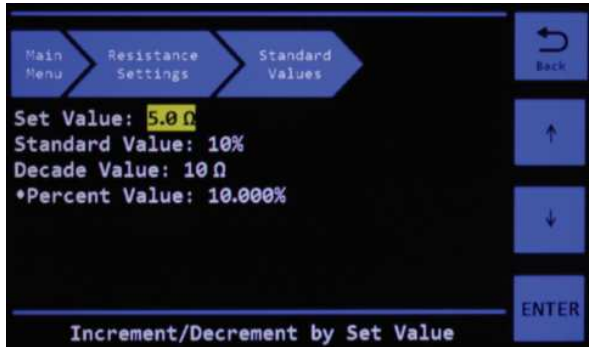


Figure 3-4 Standard Values Menu

Resistors are available in a number of standard ranges, often called ‘preferred values’ These ranges, or series, are set out by the Electronic Industries Association (EIA), and common values are E12, E24, E48, and E96. The number after the ‘E’ denotes the number of resistance values the series contains per decade.

The series are logarithmic and are derived from the resistor tolerance; resistors with a tighter tolerance can have more values in the series that won’t overlap one another. The series are sometimes referred to by the tolerance, the two being related as follows:

- E12: 10% tolerance
- E24: 5% tolerance
- E48: 2% tolerance
- E96: 1% tolerance

When a **Standard Value:** is selected on the PRS-330 pressing the **INC** and **DEC** softkeys will increment the resistance value to the next “preferred” resistance value.

RATIO-METRIC allows a custom tolerance value to be entered by the user. The default value is

3.4.5.3 Decade Value

The **Decade Value:** selection allows the resistance value to increment by a decade value in Ω s each time the **INC** and **DEC** key is pressed.

Highlight **Decade Value:** and then press the **ENTER** key to show the pull-down menu where decade values from 0.1 Ω to 10 $M\Omega$ can be selected.

When a **Decade Value:** is selected on the PRS-330 pressing the **INC** and **DEC** softkeys will increment the resistance value to the next decade resistance value.

3.4.5.4 Percent Value

The **Percentage Value:** selection allows the resistance value to increment or decrement by a specific percentage from 0.0001% to 10% each time the **INC** and **DEC** key is pressed.

Highlight **Percentage Value:** and press **ENTER** to change the set value.

When a **Percentage Value:** is selected on the PRS-330 pressing the **INC** and **DEC** softkeys will change the resistance value to the resistance value plus the resistance value multiplied by the **Percentage Value:**.

3.4.6 RTD and Other Tables Menu

Selecting the **RTD and Other Tables** menu allows use of tables.

There are 9 tables that can be selected. The first 4 tables, are defined as PT-100 $^{\circ}C$, PT-100 $^{\circ}F$, PT-1000 $^{\circ}C$ and PT-1000 $^{\circ}F$ where C is degrees Celsius and F is degrees Fahrenheit.

Press **ENTER** when **Probe Type:** is highlighted

to change between the various RTD tables.

Select **None** for no RTD table and resistance in Ω s will be displayed.

Selecting other tables the units will change to $^{\circ}C$, $^{\circ}F$, $^{\circ}K$ depending upon the table being selected.

DEFAULT is a user defined table and is configured as outlined in section 3.4.5.1.

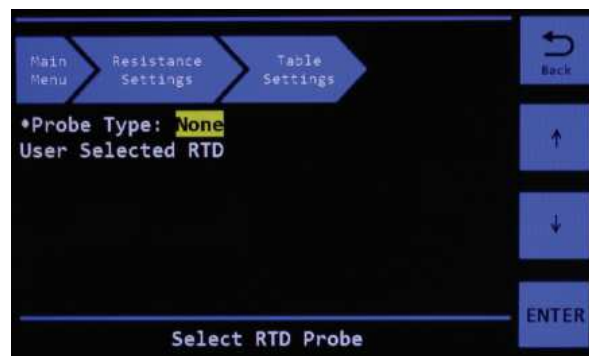


Figure 3-4 No RTD or Table

Press the **ENTER** key and then use the \uparrow key to move UP and the \downarrow to move DOWN within the items shown on screen, see Figure 3-5., to select the desired |RTD table to be used. For example pressing the **ENTER** key and using the \uparrow key to move UP and the \downarrow to move DOWN to highligh PT-100 $^{\circ}C$ and then pressing the **ENTER** key will select use of the PT-100 $^{\circ}C$ table as shown in Figure 3-5

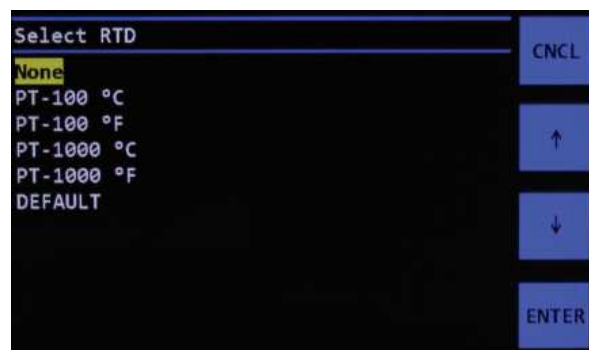


Figure 3-5 Select RTD

Once the table is selected the home screen will change for example to temperature on the display see Figure 3-6.



Figure 3-6 PT-100 °C set to 100 °C

3.4.6.1 User Select RTD Menu

Custom tables and other RTD tables can be configured by highlighting **User Select RTD** and pressing **ENTER**.

The **User Functions** menu will be shown which allows the user to add tables and specify a name for the table. See Figure 3-7

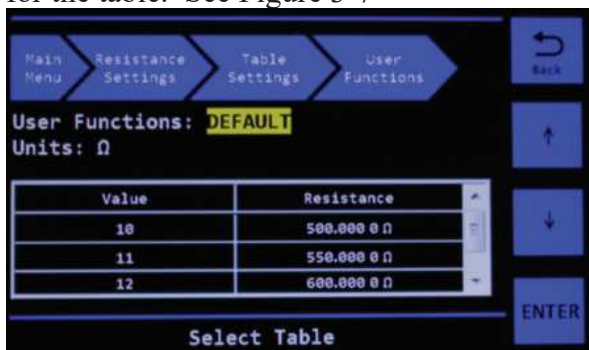


Figure 3-7 User Functions Menu

Highlight **User Functions: Default** and pressing **ENTER** opens the Select Name menu. Select **DEFAULT** From this menu you can press **ADD** or **DEL** to add or delete additional table names. See Figure 3-8.



Figure 3-8 Select Table Name

Pressing **ADD** key opens an entry screen so that a name of the table can be entered.

If there are tables which need to be deleted then highlight the table and press **DEL**.

Once the table name is entered, the table can be selected in **User Functions:** and then a value of Units of Ω, F, C or K can be entered.

Use the **↑** key to move UP and the **↓** to move DOWN between **User Functions:**, **Units:** and the **Table**.

The table shown in the bottom of Figure 3-7 can then be filled out highlighting the Table and pressing **ENTER**. This will allow you to **ADD** or **EDIT** the table.

When **ADD** is selected first enter the Value for the RTD, press **ENTER** and a prompt will be displayed for the desired resistance in Ωs. This can be done for as many points as required. The procedure within the firmware will do linear interpolation in between points so not all possible values need to be entered into the table.

3.4.7 Remote Communications Settings Menu

Highlight remote settings and press **ENTER** key to access remote settings. See Figure 3-8

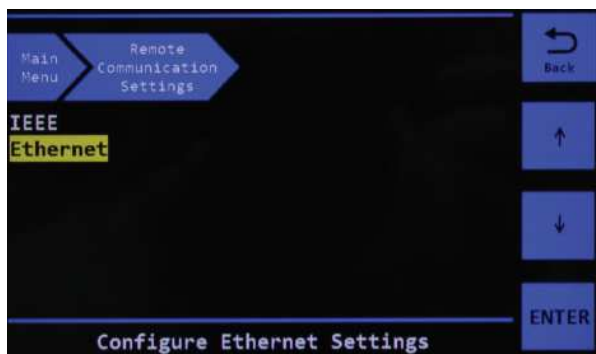


Figure 3-8 Remote Communications Settings

There are two selections IEEE and Ethernet. Highlight the interface and press **ENTER** to see the settings for the interface.

3.4.7.1 IEEE Interface Menu

Highlighting and pressing **ENTER** on **IEEE** will show the menu in Figure 3-9.

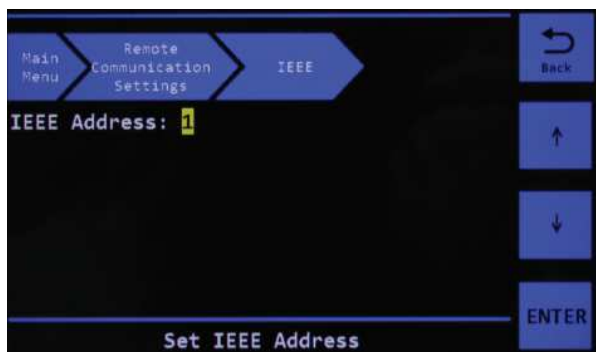


Figure 3-9 IEEE Menu

There is only one selection which is **IEEE Address:**. Pressing **ENTER** allows the IEEE address to be set from 1 to 30.

3.4.7.2 Ethernet Interface Menu

Highlighting and pressing **ENTER** on **Ethernet** will show the Ethernet menu in Figure 3-10.



Figure 3-10 Ethernet Interface Menu

There are 3 selections: IP Address:, Network Gateway:, Network Mask:, which can be highlighted and then press **ENTER** to change the value of each. Mac Address is set at the factory and only be changed via remote commands.

NOTE: After changing any Ethernet configurations, wait 3 seconds for the settings to save. Power-start the PRS and wait 10 seconds for the remote control interface to load, then on the browser attempt to load the welcome page at the IP address.

3.4.8 About Menu

The About menu shows manufacturer, Model, Serial number, Firmware (FW), Hardware (HW), and Reset to Default.



Figure 3-9 About Menu

The only item that can be highlighted and changed is **Reset to Defaults**. Pressing **ENTER** will allow the user to select **YES** or **NO** to reset all parameters back to default. The only item this reset does not affect is Calibration data.

3.5 Thermal emf Considerations

The PRS Series uses high-quality, low-emf components. Thermal emf is primarily attributable to the temperature difference between the leads of the relay and the contacts when temperature is applied to the coil. This emf is of the order of 5 μV per relay, but is not usually additive. The typical worst case is $<15 \mu\text{V}$.

If the effect of tens of microvolts is significant to your application, connect to the instrument with low-thermal-emf materials only. Copper wire and copper alloys are recommended; brass and steel should be avoided. Tinned copper and solder are acceptable.

This emf will *not* be reflected if an ac measurement instrument is employed, and can be eliminated by using a meter with “True Ohm” capability. In other cases, the emf may represent a very small component of a dc resistance measurement.

3.6 Environmental Conditions

The PRS is built, calibrated and intended for use in a laboratory environment with a nominal ambient temperature near 23°C. The accuracy of the unit may be affected when operated in non-laboratory environments. Always allow the instrument to stabilize at room temperature after unpacking or relocating the instrument. Humidity should be maintained at laboratory conditions and typically $< 50\% \text{ RH}$ non-condensing to minimize shifts in resistance.

3.7 Remote Operation

When the PRS is in **REMOTE** with front panel locked out an **REMOTE** indication will be shown in bottom half of the **HOME** screen. Pressing the **LOCAL** key will switch the PRS-330 back to local mode.

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Chapter 4

USB INTERFACE

4.1 Introduction

The USB connection is via a standard USB B female connector located on the rear panel. This can be connected to a PC via a standard USB 2.0 A Male to B Male Cable, which is included.



Figure 4-1 USB 2.0 A Male to B Male Cable

The SCPI standard provides a tree like series of standard commands for programmable instruments so that similar instruments by different manufacturers can be controlled by the same program.

4.2 Capabilities

The USB interface provides remote control over all functions except **POWER**.

4.3 USB Operation

The USB uses the command set outlined in Appendix B. Data should be terminated with LF line feed.

4.3.1 USB Interface Drivers

Normally when the PRS-330 is connected to a computer using the USB port, Windows 7 and higher will search for the correct driver and as long as the computer is connected to the internet the driver should automatically be installed.

The USB driver provides USB control through a virtual COM Port using the Microsoft's standard driver for Virtual COM Ports.

Data rates and formats are below;

Baud rate: 9600 baud

Data bits: 8

Parity: none

Stop bits: 1

If the driver cannot be found the USB interface uses a standard MCP2200 Driver. Drivers can be found at the link below if the drivers are not automatically installed.

<http://www.ietlabs.com/Drivers/MCP2200.zip>
or <http://www.ietlabs.com/prs-300-ieee-ethernet.html>

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Chapter 5

ETHERNET INTERFACE

5.1 Ethernet Programming

The PRS-330 comes with Ethernet remote programming capability accessed through the RJ45 LAN connector. The connector is a RJ45 industry-standard connector found on the rear panel. The PRS's Ethernet connection is based upon the ICS Ethernet/GPIB/USB to Serial Interface Card. More information can be found at www.icselect.com on the 9006 Ethernet/GPIB/USB to Serial Interface Card.

Ethernet Protocols

The PRS-330 supports Raw Socket and the VXI-11 protocol which makes it easy to control from a PC or over the company network.

Raw socket lets you telnet to it and is best used with direct PC to instrument applications. VXI-11 operates over Sun RPC and is a more secure protocol that mimics GPIB control of an instrument and provides secure communication over a company network or over the Internet.

Raw Socket Operation

The PRS-330 is always ready for a telnet connection. When connected, the PRS outputs its IDN message to confirm the connection.

All raw socket messages are terminated with a linefeed. Carriage returns and ignored. A backspace character causes the prior character to be deleted. Communication timeout is two minutes and it is recommended that the client issue a Space-BS sequence on an occasional basis, less than the timeout, to reset the timeout

counter.

VXI-11 Background

VXI-11 is a communication standard developed in conjunction with the VISA Specification. The specification defines a VXI-11.3 interface like the PRS as an instrument which can be controlled in Windows systems by programs that make VISA or SICL library calls and in UNIX/LINUX or similar operating system with RPC calls. The VXI-11 specification provides an RPCL (Remote Procedure Call Library) that can be used by virtually any operating system to control the PRS. Microsoft's RPC is not ONC compliant and cannot be used with a VXI-11.3 device like the PRS. An VXI-11.3 interface like the PRS will operate in an LXI system and it supports LXI's 'VXI Discovery Method'.

5.2 Network Setup

The PRS-330 includes an internal WebServer with HTML web pages that can be accessed by a web browser from any computer. The web pages let the user quickly change the PRS network settings. The default IP address is 192.168.1.253 static.

5.3 Ethernet Test Keyboard

To assist the user in setup and communication the VXI-11kybd program can be used which includes defined RPC calls to change the PRS

network settings.

VXI-11 Keyboard Control Program provides interactive control of VXI-11 instruments from the computer keyboard without having to write a program. The VXI-11 Keyboard program is the ideal utility program for configuring and testing the PRS or any VXI-11 compatible instrument. Use the VXI-11kybd program to exercise the interface or to try out commands before using them in a program. The VXI-11kybd program can be found on the PRS product page at www.ietlabs.com

Versatile Programming

The PRS-330 can be easily controlled by several programming techniques and languages because it is a VXI-11.3 instrument. If you program with LabVIEW, National Instruments' VISA supports VXI-11.3 instruments like the PRS. NI's Measurement and Automation Explorer treats the PRS as a TCP/IP compliant device. Agilent's VISA library supports VXI-11.3 instruments and the Agilent Connection Manager sees the PRS as a TCP/IP instrument.

If you are a Visual Basic, VB.Net or C/C++ programmer, you can write your program to call Agilent's or National Instruments' VISA or Agilent's SICL library in the Windows environment.

If you use LINUX or any other flavor of UNIX like SunOS, IBM-AIX, HP-UX, or Apple's OS X, you can communicate with the PRS through RPC over TCP/IP. RPC (or Remote Procedure Calls)

provides an invisible communication medium for the developer. The VXI-11 specification provides an RPCL (Remote Procedure Call Library) that can be used by virtually any operating system to control the PRS.

If you program with Java then you can write a PRS control program that can be easily moved to many different operating systems.

The Java jGpibEnet project on SourceForge was developed using an ICS 8065 Controller similar to the PRS Controller.

5.4 Network Configuration

This paragraph configures the 9006 card in the PRS for operation on your network. The board's digital interface is configured later by sending commands as outlined in Appendix A.

When shipped, the boards are configured with default settings outlined in Table 4-1 Default Settings.

Command	Function	Factory Setting
IP Mode	Static or DHCP Mode	Static
IP Address	0.0.0.0 to 255.255.255.255.0	192.168.1.254
Net Mask	0.0.0.0 to 255.255.255.255.0	255.255.255.0
COMM Timeout	Sets socket timeout	120 sec.
Auto Disconnect	Aborts socket if link count goes to 0	Off

Table 4-1 Default Settings

Review the Table with your network administrator and decide on which settings, if any, that need to be changed. Table 4-1 provides detailed information about each network setting to help you with your decisions. The minimum change is to set a static IP address so your PC can communicate with the board.

NOTE: After changing any Ethernet

configurations, wait 3 seconds for the settings to save. Power-start the PRS and wait 10 seconds for the remote control interface to load, then on the browser attempt to load the welcome page at the IP address.

The network configuration can be changed and the board's MAC Address can be read with a web browser, by running ICS's VXI-11 Configuration Utility on a WIN32 or WIN98 PC. ,

5.5 Web Browser Configuration Method

This method uses a standard browser such as Firefox, Internet Explorer or Safari to view and change the current network settings.

1. Temporarily disconnect the computer from the company network. Connect the PRS and computer running the browser using a standard Ethernet Cables to a hub or switch. Temporarily disconnect the local network connection to avoid network conflicts until the board is configured.

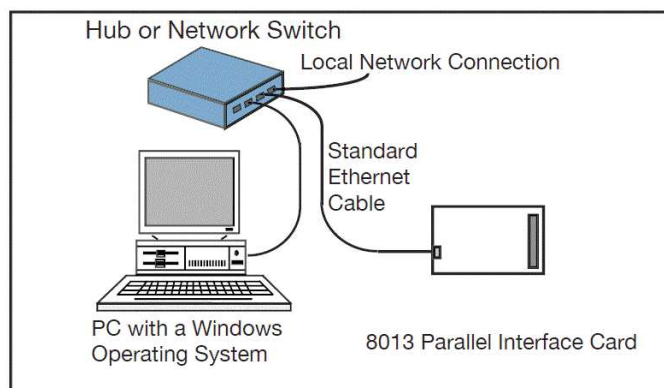


Figure 4-1 9006 Connected to the local hub

An alternate connection is to use an Ethernet Crossover Cable to connect the computer directly to the PRS for initial configuration. This will eliminate any potential network conflicts while configuring the PRS.

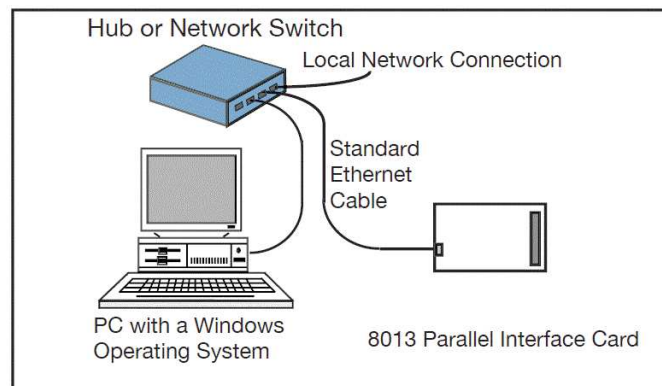


Figure 4-2 9006 Connected to the local hub

2. Apply power to the PRS. Set the Remote local switch to Remote.
3. Check your computer's network settings to be sure its IP address is in the 192.168.1.xxx range so it can communicate with the PRS Ethernet board's default IP address. If it is not, it must be set before proceeding. Use the values shown below. For Windows PCs, right-click on My Network Places and click on Properties. Right-click on Local Area Connection and click Properties. Highlight Internet Protocol (TCP/IP) and click Properties. If your PC's IP address is in a different range, record the current settings and temporarily set the following network values:

Check 'Use the following IP Address'
 IP Address 192.168.1.254
 Subnet mask 255.255.255.0

4. Open the browser and enter the default IP address of 192.168.1.254 for new units (or your last set address for older units) in the browser address window.
5. A Welcome Page similar to the one shown Figure 4-3 should appear in your browser.
6. If you want to change any of the settings, press the 'Update Configuration' key. A Configuration Page similar to the one shown in Figure 4-4

should appear in your browser.

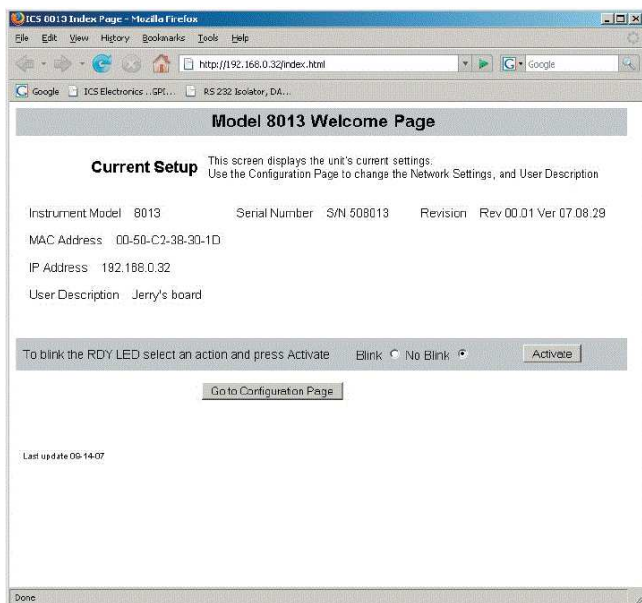


Figure 4-3 9006 Welcome Page

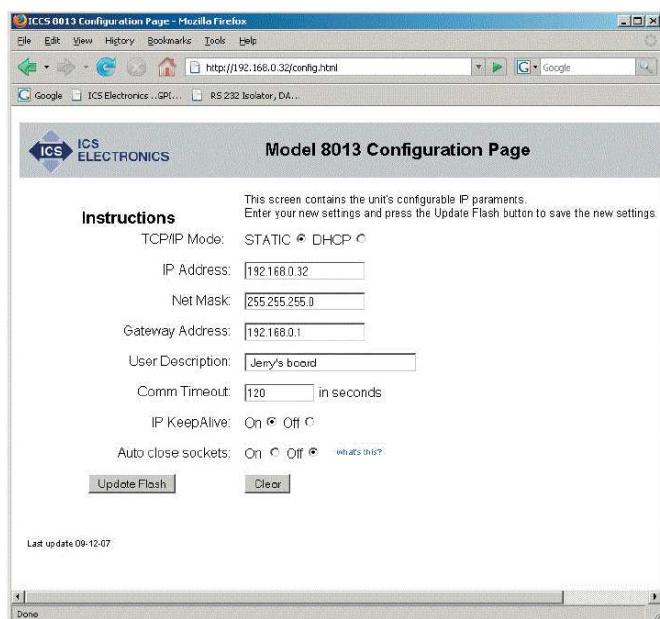


Figure 4-4 9006 Configuration Page

7. Enter the new settings as desired. If you select DHCP for the TCP/IP Mode, the page blanks out the IP, Net and Gateway addresses as they will be supplied by your DHCP server. Check the entered values carefully as the unit’s webserver does minimal error checking. Press the ‘Update

Flash’ key when done. A Confirmation Page similar to the one shown in Figure 4-5 will appear in your browser.

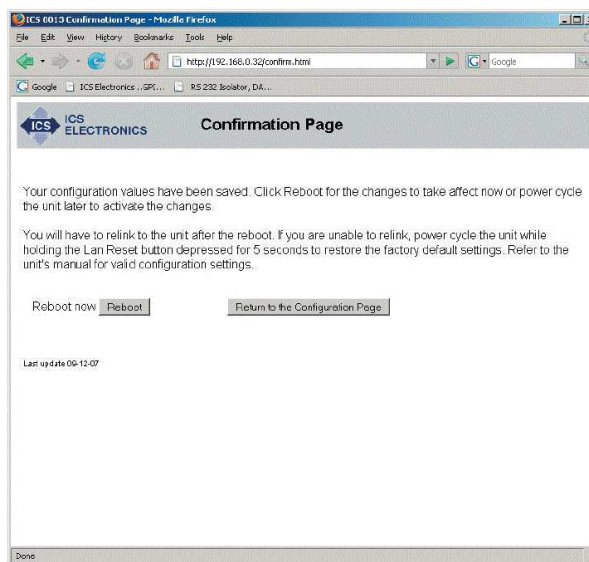


Figure 4-5 9006 Confirmation Page

8. Your new settings have been saved in the board’s flash memory. You have to reboot the unit or power cycle it for the changes to take affect. Press the ‘Reboot’ key to reboot the unit now or the ‘Return to the Configuration Page’ key to revisit the new settings.

5.6 VXI-11 Configuration Utility Method

The VXI-11 Configuration Utility program is called ‘VXI11_config.exe’ and runs in any WIN32 PC with Windows 98, Me, 2K, XP, Vista, 7 and Server 2003 operating systems. The VXI11_config.exe program can be found on the PRS product page at www.ietlabs.com.

The VXI11_config program can be run from the CD or can be installed onto your hard disk and run from the installation directory.

VXI11_config.exe is a Visual Basic program and requires that either Microsoft’s Visual Studio 6 or VBruntime6 be installed on your PC to run.

1. Connect the board directly to the WIN32 PC that will be running the Configuration Utility. Disconnect the PC from the company network and use the supplied Ethernet Crossover Cable to connect the PC to the board as shown in Figure 4-6. This will eliminate any potential network conflicts while configuring the board.

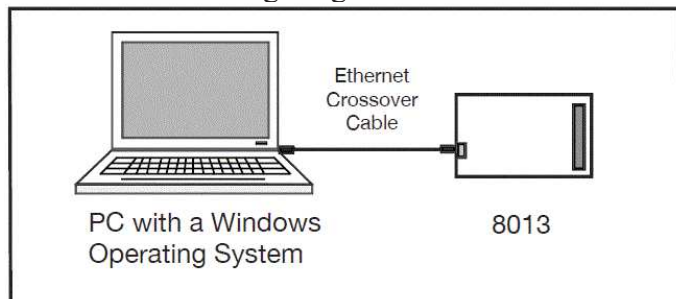


Figure 4-6 9006 Connected to PC with a Crossover Cable

Alternately, use a standard Ethernet patch cable to connect the 9006 to the same hub or switch that the PC running the Configuration Utility is connected to as shown in Figure 4-7. Temporarily disconnect the local network connection to avoid network conflicts until the board is configured.

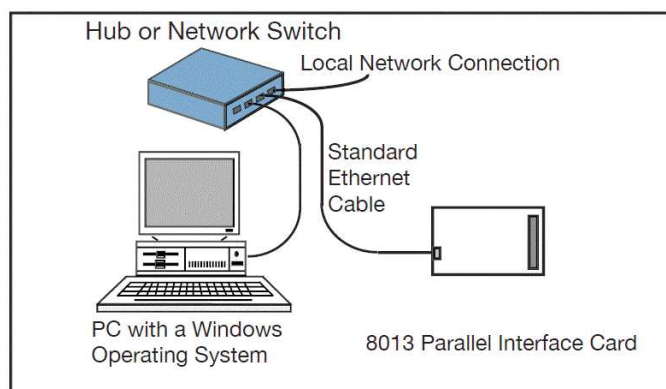


Figure 4-7 9006 Connected to the local hub

2. Apply power to the board

3. Check your PC's network settings to be sure its IP address is in the 192.168.1.xxx range so it can communicate with the board's default IP address. To check, right-click on My Network

Places and click on Properties. Right-click on Local Area Connection and click Properties. Highlight Internet Protocol (TCP/IP) and click Properties. If your PC's IP address is in a different range, record the current settings and temporarily set the following network values:

Check 'Use the following IP Address'
 IP Address 192.168.1.254
 Subnet mask 255.255.255.0

4. Run the VXI11_config program. The Configuration Utility opens a window as shown in Figure 4-8. Initially only the Find Server, Help and Exit keys are enabled on the program window. The other keys will be enabled as you advance through the program.

5. Click on the Find Server key. The program scans for all VXI-11 Services connected to the local LAN or to your PC. (The 9006 is an RPC server which provide a VXI-11 Service) The results are displayed in the Results box.

6. When the servers(s) have been found, use the pulldown arrow in the Found Servers box to view the Found Server addresses. The board's default address is 192.168.1.254. Highlight the board's IP address and click the Create Link key. If the server is not found, you can enter the default IP address (192.168.1.254) in the Found Servers box. Click the Create Link key.

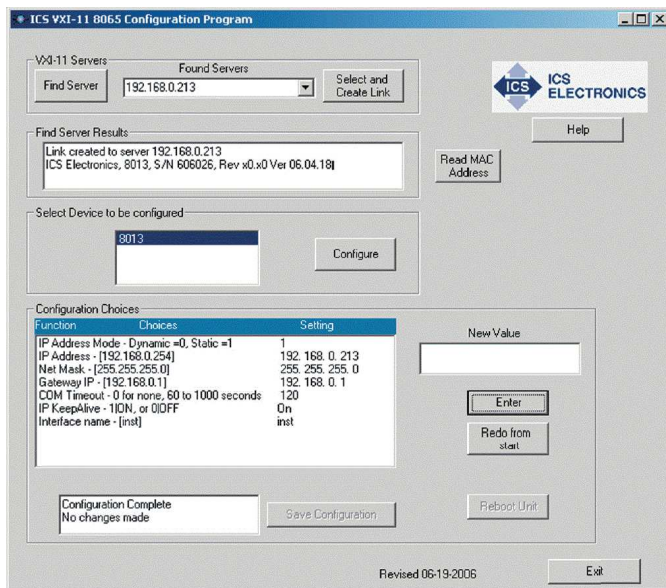


Figure 4-8 VXI-11 Configuration Utility

(Showing all configuration choices with no changes)

7. When the link has been created, device model number(s) will appear in the ‘Select Device to be Configured’ box. Highlight the desired model number and click the Configure key to start the configuration process.

8. The Configuration Choices box displays only one line with the first parameter to be changed and its current setting. If you like the current setting, click Enter to advance to the next parameter. If you want to change the setting, type a new value in the New Value box and click Enter. The program will send your setting to the board and read back the new setting. Repeat as needed to make another change or click Enter again to advance to the next parameter.

9. Repeat step 8 for each configuration parameter. Figure 4-8 shows the VXI-11 Configuration Utility after all parameters have been entered for a Model 9006. Click the Redo From Start key if you need to start over or if you want to change any of the prior settings

10. When done, the Save Configuration key is enabled if you changed any settings. Click the Save Configuration key to save the values in the board’s flash memory. If you did not make any changes you can just exit the program.

11. The board has to be power cycled or rebooted before the configuration changes take affect. Click the Reboot key to reboot the board and use the new settings.

12. Press the Exit key to quit the VXI11_conf program.

13. If the IP address was changed to an address outside the 192.168.1.xxx range in step 3, your PC’s network settings will have to be changed to communicate with the board. Exit the VXI11_conf program and restore the PC’s network settings.

5.7 Resetting Default Network Settings

The board can be reset to the default network settings listed in Table 4-2 at any time by holding the LAN Reset Key in for 5 seconds while applying power to the board. Access to this key is on the rear panel of the PRS-330.

The Digital I/O configuration values are not affected by the LAN Reset operation.

Command	Function	Factory Setting
IP Mode	Static or DHCP Mode	Static
IP Address	0.0.0.0 to 255.255.255.255.0	192.168.0.2
Net Mask	0.0.0.0 to 255.255.255.255.0	255.255.255.0
COMM Timeout	Sets socket timeout	120 sec.
Auto Disconnect	Aborts socket if link count goes to 0	Off

Table 4-2 Default Settings

5.8 PRS Programming

A PRS SCPI command reference is included in Appendix A. This gives a complete set of commands.

An example of commands to be sent to place the PRS in remote, this must be done first otherwise there will be no remote control of output impedance, and then configure the unit for a specific impedance value.

Where the command string is constructed as described in Appendix A and Appendix B.

A command string might be, for example:

SOURce:DATA 100000.1

Chapter 6

IEEE INTERFACE

6.1 Introduction

The PRS-330 is a IEEE-488.2-1987 and SCPI 1994.0 compatible instrument. The PRS-330 IEEE-488 interface is based upon the ICS Ethernet/GPIB/USB to Serial Interface Card.

More information can be found at www.icselect.com on the 9006 Ethernet/GPIB/USB to Serial Interface Card.

Commands sent to the PRS-330 must be terminated with line feed <LF> or carriage return and line feed <CRLF>.

The IEEE interface can be programmed via any of the commands listed in Appendix A and B.

It is also important to use 488 commands when using MetCal rather than 488.2 commands.

The terminator CRLF should also be used with Met Cal as shown below.

```
1.001 IEEE SOURCE:DATA 20.1 [13][10]
```

The SCPI standard provides a tree like series of standard commands for programmable instruments so that similar instruments by different manufacturers can be controlled by the same program. SCPI information and a command reference are located in Appendix A.

Other tutorials are available on-line; consult IET for additional information. A software GPIB “keyboard” can be found at www.ietlabs.com

6.2 Capabilities

The IEEE option provides remote control over all functions except **POWER**. The IEEE option responds to all Basic Commands in Appendix B and all IEEE.2 Mandated common commands in Appendix A.

6.3 Address Switch and Communications Settings

The default GPIB address is 4. This address can be changed remotely by sending the command `SYSTEM:ADDR <n>` where n is 0 - 30.

6.4 GPIB Test Keyboard

To aid the user in operating the PRS, a GPIB “Keyboard” Controller program - the easiest way to control GPIB devices without writing a program - is available from IET. This GPIB Keyboard program automatically finds your device at start-up and it lets you enter just the data that you want to send to the device. This program

works with ICS, Measurement Computing and National Instruments controllers.

To implement, request a download of **ICS_GPIBkybd_Install.zip** from IET Labs Tech Support.

Unzip the file and follow instructions to install.

Open the application. You may use the **Find Listeners** key to confirm that the PRS unit is recognized. Other instruments may also be recognized at this time.

Enter and set the **Address** to the PRS address. Use the window to send a **command string** to the PRS,

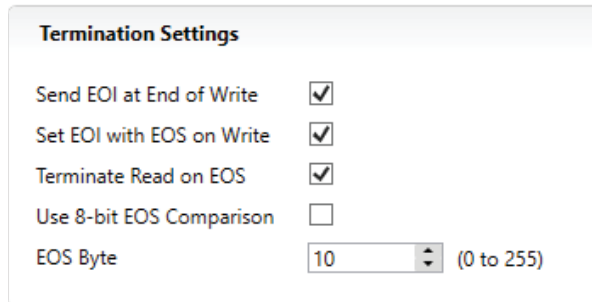
where the command string is constructed as described in Chapter 7. A command string might be, for example:

```
SOURce:DATA 12.34567
```

6.5 GPIB Control with National Instruments NI-MAX and Programmatically

Open NI-MAX, expand devices and interfaces, select NI GPIB-USB-HS "GPIB0" or GPIB interface being used.

Set the terminations settings as shown



From NI-Max Measurement and Automation Explorer you can now click on scan for instruments.

The PRS-370 will be found at address 4.

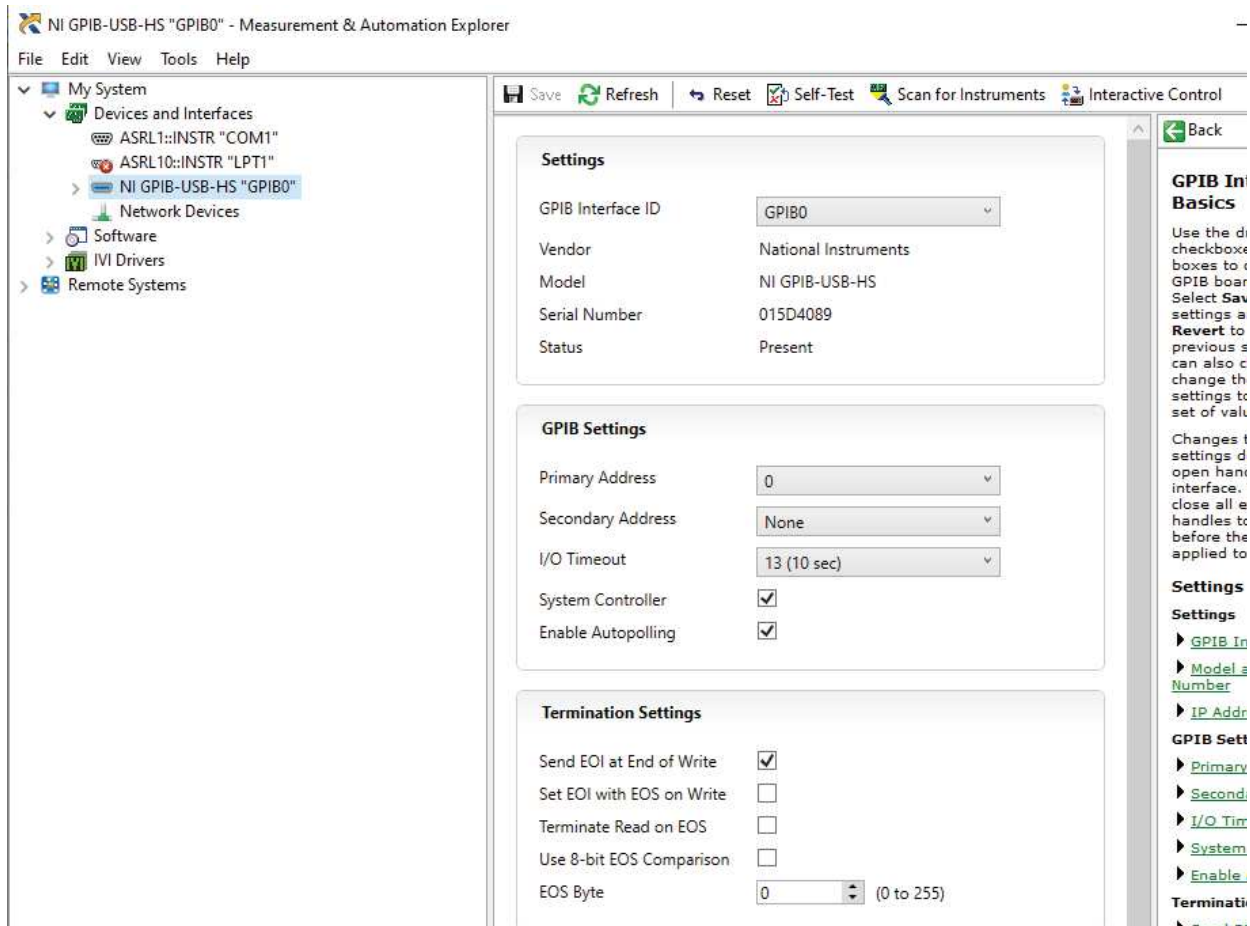
When you send a command in NI-Max make sure you send *IDN?\n or SOURCE:DATA 20.1\n.

Sending \n indicates the terminator will also be sent.

It is also important to use 488 commands when using MetCal rather than 488.2 commands.

The terminator CRLF should also be used with Met Cal as shown below.

1.001 IEEE SOURCE:DATA 20.1 [13][10]



Chapter 7 PROGRAMMING

7.1 Program Commands

Take advantage of the applications such as **ICS_VXI-11** and **ICS_GPIBkybd** that can be downloaded from on ietlabs.com to test communication via Ethernet, IEEE and USB to become familiar with programming and verify communications.

The USB, Ethernet and IEEE interface can be programmed via any of the commands listed in Appendix A and B.

For USB <lf>, <cr> or <crlf>, can be used as terminator. The device returns in this case <crlf>.

The device performs all commands previously sent after it receives a terminator.

Commands not recognized have no effect on the unit's operation and will set the corresponding bits in the Standard Event Status Register.

SCPI commands that end with a question mark '?' are queries.

All queries should be followed by reading their response to avoid data loss.

Semicolon ';' is used to separate more commands written on one line.

Note: Only one query command should be send at one time so use of ";" as a separator is not value for multiple commands ending in "?".

Note: Commands from Appendix A should not be combined with commands from Appendix B using a semicolon. These should be sent as separate lines.

Examples

Examples of commands that are valid and can be strung together using a semicolon.

The command below sets the PRS-330 to 4 -wire, rear output terminals, switching between commands to short and sets the source resistance to 222 Ω.

```
CONF:SEL4;CONF:TERMREAR;CONF:SWIT
SHORT;SOUR:DATA 222
```

This command string can be abbreviated to;

```
CONF:SEL 2;;TERM REAR;;SWIT
OPEN;SOUR:DATA 122
```

Setting source resistance and then reading the source resistance back can be accomplished using the following;

```
SOUR:DATA 122;SOUR:DATA?
```

The data should then be read and the PRS-330 will return 122.00000.

Other command that can be combined for example are;

```
*CLS;*OPC?
*CLS;*IDN?
```

Care must be taken when sending the *RST command. This command resets the PRS-330 and it cannot be combined with any other commands.

The *RST command should be sent as;
*RST

A delay is need prior to sending any other commands to ensure the PRS-330 restarts and finishes self-test.

Invalid commands

Example of invalid commands are:

*cls;source:data 300
SOUR:DATA 322;*OPC?

These command combine commands from Appendix A and Appendix B using a semicolon. Any commands sent will be ignored.

SYSTEM:SVER?;SYST:HVER?

This combines to query commands separated by a semicolon and the command will be ignored.

*RST;*OPC? or <any command>

*RST should not be combined with any other command and time should be given to the PRS-330 to complete self-test prior to sending any additional commands.

CONFigure commands and SOURce commands should not be combined.

CONF:SEL4;CONF:TERMREAR;CONF:SWIT
SHORT;SOUR:DATA 222;SOURCE:DATA?

This command should be separated into 2 command strings;

CONF:SEL4;CONF:TERMREAR;CONF:SWIT
SHORT

SOUR:DATA 222;SOURCE:DATA?

Chapter 8

MAINTENANCE

8.1 Verification of Performance

8.1.1 Calibration Interval

The PRS Series instruments should be verified for performance at a calibration interval of twelve (12) months. This procedure may be carried out by the user, if a calibration capability is available, by IET Labs, or by a certified calibration laboratory. If the user should choose to perform this procedure, then the considerations below should be observed.

8.1.2 General Considerations

It is important, whenever testing the PRS Series Decade units, to be very aware of the capabilities and limitations of the test instruments used. Such instruments have to be significantly more accurate than the specified accuracy for all applicable ranges in order to perform this task, allowing for a band of uncertainty of the instrument itself, the test setup and the environment; consult IET Labs for information.

It is important to allow both the testing instrument and the PRS-330 to stabilize for a number of hours at the nominal operating temperature of 23°C, and at nominal laboratory conditions of humidity. There should be no temperature gradients across the unit under test.

In the case of the PRS-330 a Kelvin type 4-wire test terminals should be used to obtain accurate

low-resistance readings.

Steps should be taken to minimize thermal-emf effects, by maintaining an even temperature and by using only low-emf connectors. Use of meters with a “True Ohm” function is recommended.

Proper metrology practices should be followed in performing this verification.

8.1.3 Calibration Procedure

Equipment Required:

Keysight 3458A, Fluke 8508A, 8588A or equivalent
KK-100, TL-600 Kelvin Cable or equivalent.

Procedure:

Configure the DMM for 7 ½ digits of resolution or better, Range Auto, Fast off, Filter Off, LOI Off, Zero function and 4 wire measurements.

The Fluke DMM should use Tru-Ω for resistances < 20 kΩ, Ohms for > 20 kΩ to < 2 MΩ and Hi-V for values above 2 MΩ.

The DMM should be zeroed prior to use. Please see the manufacturers instruction manual for more information on performing a zero with the specific DMM.

The gold shorting links must be removed on the binding posts of the PRS-330.

Connect the DMM to the front binding posts of the PRS-330 using a 4 terminal Kelvin connection.

The PRS-330 consists 43 internal resistors which are combined in either series or parallel to achieve the programmed resistance.

These resistors require periodic measurement to keep the PRS-330 within published specifications.

The resistors are measured using a DMM. The measured value is then stored in a table within the memory of the PRS-330. The measured values of the resistors are used in an algorithm to determine which resistors are used to create the programmed resistance value.

In addition to the 43 resistors the residual internal lead resistance is also measured at time of manufacture and entered into memory. The internal lead resistance does not need to be measured again unless repair has been performed to the PRS-330.

Below is a list of the 43 resistors and their nominal resistance value. These resistors should be within the percentages below to ensure the unit meets accuracy specifications.

$\pm(1\% + 5 \text{ m}\Omega)$ of the nominal value for R1 to R3

$\pm 1\%$ of the nominal value for R4 to R5

$\pm 0.1\%$ of the nominal value for R6 to R17

$\pm 1\%$ of the nominal value for R18 to R24

$\pm 10\%$ of the nominal value for R25 to R31

$\pm 0.1\%$ of the nominal value for R32 to R43

The Calibration History will show each resistor value and previous calibrated values so that drift of the individual resistors can be evaluated.

Resistance Number	Nominal Resistance Value
R1	0.172 Ω
R2	0.350 Ω
R3	0.700 Ω
R4	1.370 Ω
R5	2.660 Ω
R6	5.150 Ω
R7	10.20 Ω
R8	20.00 Ω
R9	38.80 Ω
R10	75.60 Ω
R11	148.0 Ω
R12	287.0 Ω
R13	570.0 Ω
R14	1.13 kΩ
R15	2.23 kΩ
R16	4.40 kΩ
R17	8.70 kΩ
R18	17.0 kΩ
R19	33.3 kΩ
R20	66.0 kΩ
R21	130.0 kΩ
R22	258.0 kΩ
R23	506.0 kΩ
R24	1.0 MΩ
R25	2.0 MΩ
R26	3.99 MΩ
R27	7.8 MΩ
R28	15.0 MΩ
R29	30.0 MΩ
R30	60.0 MΩ
R31	120.0 MΩ
R32	3.55 kΩ
R33	7.39 kΩ
R34	16.4 kΩ
R35	33.8 kΩ

R36	72.2 kΩ
R37	147.0 kΩ
R38	300.0 kΩ
R39	600.0 kΩ
R40	1.23 MΩ
R41	2.48 MΩ
R42	5.0 MΩ
R43	10.0 MΩ

During the adjustment process the firmware cycles through each resistor and the technician can enter the measured resistance value in ohms. This should be done with a minimum of 7 ½ digits of resolution. The accuracy of measurement should be significantly more accurate than the ±(70 ppm + 1 mΩ) for all resistance values.

8.1.5 Calibration Menu and Process

To enter into the calibration process, press the **MENU** key, push in the **CAL ENABLE** key and keep pressed, and then select **Instrument Calibrate**.



Figure 8-1 Main Menu with CAL ENABLE pressed

Only when the **CAL. ENABLE** key is pressed does the **Instrument Calibration** selection become available.

Select **Instrument Calibration** and press **ENTER**. The menu in Figure 8-2 will be shown. Once this menu is displayed the **CAL. ENABLE**

key can be released.

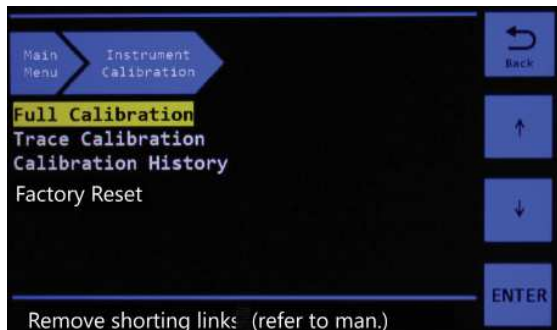


Figure 8-2 Instrument Calibration Menu

Full Calibration allows calibration of 1 or all 43 resistors.

Trace Calibration is only required if the PRS-330 requires service which involves changing of the relay board, or internal wiring between binding post and the relay board. This compensates for the buss wire resistance between the main board and binding posts.

Calibration History allows the history of each resistor to be reviewed showing resistance at each calibration date.

8.1.6 Full Calibration (adjustment)

Full Calibration can be performed by selecting Full Calibration and pressing the **ENTER** key. A password is required as shown in Figure 8-3.

Figure 8-4 shows entry of the password which is **IET**. note tapping twice on the alpha keys will select the second letter.

At the end of the process select all calibration values will be saved into memory. At anytime pressing the **MENU** key will exit calibration without making any changes.



Figure 8-3 Password entry screen



Figure 8-4 Entry of IET as password

Once the password IET has been input via touch screen press the **ENTER** key. This will open the Calibration screen as shown in Figure 8-5.



Figure 8-5 Resistor 1 Calibration Screen

The process is to measure the resistance with

a DMM using a 4 terminal Kelvin connection, making sure the shorting links are not on the binding post.

IET Labs uses the Fluke 8508A, set to 7 ½ digits of resolution, during the adjustment process to ensure the PRS-330 meets specifications.

IET Labs offers the PRS-DMM software which works with the PRS-330 and Fluke 8508A or Keysight 3458A to automate this adjustment process. See Chapter 9.

Once the resistance is measured the resistance value can be manually entered in ohms using the keypad.

Once the resistance has been entered the NEXT key can be pressed to move to the next resistor value R2. The PREV key can be used to go back to the previous resistance value if required. There are 43 resistors which require calibration.

At anytime during the process the CNCL key can be pressed to cancel the calibration process. Cancelling the calibration process will not save any calibration data taken and the previous calibration data is used.

Pressing the EXIT key will save the current calibration data into memory. You will be prompted to enter the calibration date. and then the data is saved into memory. This data can be reviewed in the Calibration History menu.

8.1.7 Calibration History

The Calibration History menu is in the Calibration menu. This allows the use to view the resistance and date the adjustment procedure as perform in Section 8.1.4.

This information can be used to look at the drift of each of the 43 internal resistors. This data can

be viewed in this menu. If exporting this data is required see Appendix B remote commands which allow this data to be transferred to a PC.



Figure 8-6 Calibration History Menu

From the Instrument Calibration menu select Calibration History and press ENTER. The menu in Figure 8-6 will be shown.

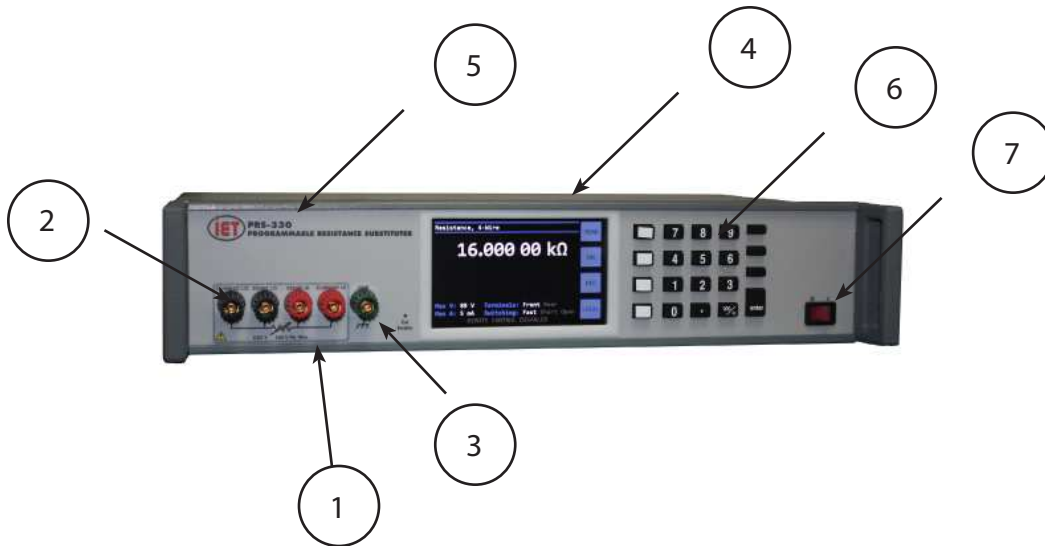
Each time an internal adjustment of the resistors is performed and saved per Section 8.1.4, a new line is added in the table.

Use the **↑** key to move UP and the **↓** to move DOWN which will show the resistors R1 to R43 and the calibration history of each resistor.

Press CNCL to return to the previous Instrument Calibration menu.

8.2 Replaceable Parts List

Model Ref	IET Pt No	Description
1	BP-1000-RD	Binding Post, Red
2	BP-1000-BK	Binding Post, Black
3	BP-1000-GN	Binding Post, Green
Not Shown	PRS-330-Bail-Feet kit	4 x feet and bale kit
Not Shown	PRS-330 Relay Board	Relay Board Complete
Not Shown	PRS-330 CPU Board	CPU Board Complete
Not Shown	PRS-330 Remote Interface	USB,IEEE,Ethernet Interface Card
4	PRS-330 Touch Screen	Touch Screen
Not Shown	PRS-330 BP Board Front	Binding Post Board Front
Not Shown	PRS-330 BP Board Rear	Binding Post Board Rear
5	PRS-330 FP	Front Panel with Overlay and Bezel
6	PRS-330 Keypad	Keypad and Keypad board
7	PRS-330 Power Switch	Power Switch Illuminated



Chapter 9

PRS-DMM Self Adjusting Software

9.1 PRS-DMM Self Adjusting Software

9.1.1 Overview

The PRS-DMM Self Adjusting Software is a Windows based software package using LabVIEW 2013 RTE.

The software is designed to be used with the PRS-330 Programmable Resistance Substituter and the Keysight 3458A or Fluke 8508A DMMs.

The DMM is used to measure the resistance of the PRS-330, and then the software adjusts the output resistance of the PRS-330 to achieve the closest possible resistance value to the target resistance value.

This can improve the accuracy of the PRS-330 from $\pm(70 \text{ ppm} + 1 \text{ m}\Omega)$ to better than $\pm 10 \text{ ppm}$ short-term without switching.

9.1.2 General Requirements

The PRS-DMM Self Adjusting Software does require:

- Windows 8 or Windows 10 PC
- National Instruments GPIB-USB-HS or equivalent GPIB interface
- Fluke 8508A DMM or Keysight 3458A DMM
- PRS-330 Programmable Resistance Substituter

- Kelvin cables between PRS-330 and Fluke 8508A
- GPIB cables as necessary

9.1.3 Software Installation

Install the PRS-DMM Self Adjusting Software using the supplied USB stick. This will install the PRS-DMM software as well as the LabVIEW 2013 RTE. This software is also available at <http://www.ietlabs.com/prs-dmm.html>

If using the PRS-330 with standard USB interface, MCP2200 driver should be installed.

9.1.4 Connection between DMM and PRS-330

Connect the PRS-330 to the DMM using good quality low thermal EMF cables using a 4 terminal kelvin connection.

If the end use of the PRS-330 will be 2 Wire then keep shorting links installed. In the menu of the PRS-330 it should be configured for “2W” Mode.

If the end use of the PRS-330 will be 4 wire then remove shorting links. In the menu of the PRS-330 it should be configured for “4W” mode.

See section 3.4.10 for more information on 2-wire and 4-wire connections.

9.1.5 Connections of PRS and .DMM

Connect the 3458A or 8508A DMM to the PC via GPIB. Connect the PRS-330 to the PC via GPIB or USB. Make sure the addresses are different on DMM and PRS-330.

9.2 PRS-DMM Main Screen

The main screen of the PRS-DMM software is shown below.

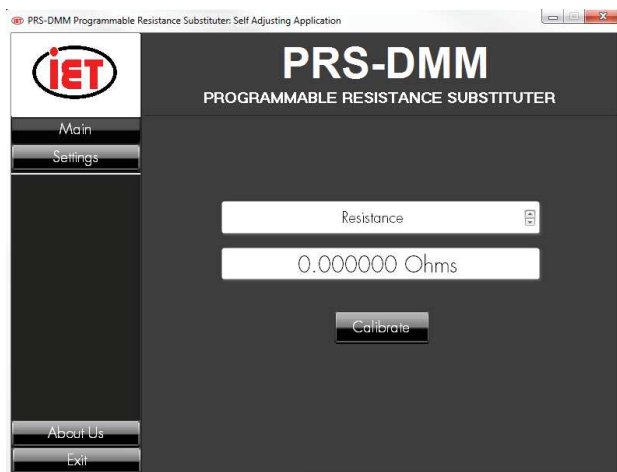


Figure 9.1 PRS-DMM Main Screen

There are 4 keys; Main, Settings, About Us and Exit.

9.2.1 PRS-DMM Main Screen Operation

The main screen of the PRS-DMM allows the user to select Resistance or RTD tables, and it also allows to be entered the target resistance value or temperature.

Assuming that the PRS-330 is connected to the PC and turned on, any value entered as a target value will automatically switch the PRS-330 to that resistance or resistance equivalent to the entered temperature value.

Clicking on the Calibrate key starts the process of adjusting. The DMM Measures and adjusts the PRS-330 to achieve the closest value possible to the entered target value. The accuracy depends upon the MEASUREMENT SPEED . See section 9.3.5.

9.3 PRS-DMM Settings

9.3.1 PRS-DMM Settings Screen

The Settings screen is shown in Figure 9.2. This menu should be configured first to set address of the PRS-330 and DMM.

This menu also allows for adjustment of the PRS-330 which automates the adjustment process of the PRS-330 as described in section 8.4.1.

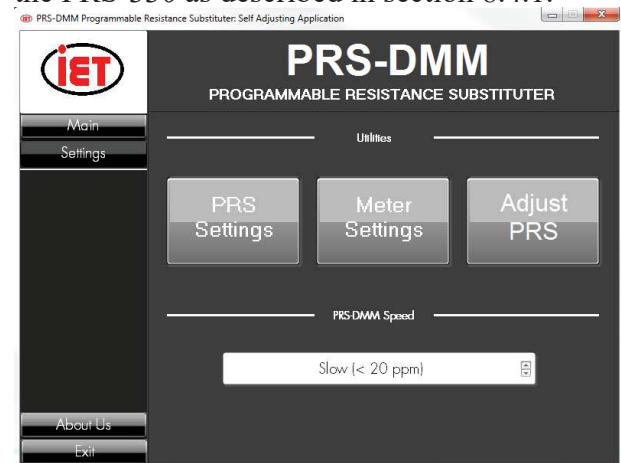


Figure 9.2 PRS-DMM Settings Screen

9.3.2 PRS Settings

PRS Setting screen allows the operator to select the COM port or GPIB address of the PRS-330. Make sure the PRS-330 and DMM are turned on and connected to the PC.

If the address or COM port of the PRS-330 or DMM is not shown in the I/O box then click on refresh. Select the GPIB address or COM port and then click the Initialize key. The IDN string

will be shown in the white box along with a Success indication.

Click Exit key to return to Setting Screen once PRS has been detected.



Figure 9.3 PRS Settings Screen

9.3.3 Meter Settings

Meter Setting screen allows the operator to select which DMM will be used either the Fluke 8508A or the Keysight 3458A. The GPIB address of the DMM can also be set in this menu. Make sure the DMM is turned on and connected to the PC.



Figure 9.4 Meter Screen

Select the GPIB address and then click the Initialize key. The IDN string will be shown in the white box along with a Success indication. The PRS-DMM software will configure the DMM for resistance measurements, appropriate resolution 7 ½ digits for slow, 6 ½ digits for medium and fast, 4 wire measurements and autorange ON.

The 8508A will also be configured for Low Current, Fast AD Integration OFF, and Analog Filter OFF.

If additional commands need to be sent to the DMM, click on the Configure Key and enter the commands in the text box.

Once the commands have been entered press the Configure key. Any commands will be sent to the DMM during initialization of the DMM.

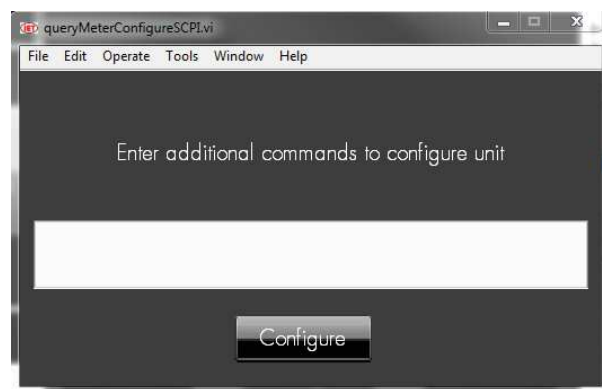


Figure 9.5 Meter Configure Screen

Click Exit key to return to Setting Screen once DMM has been detected.

9.3.4 Adjust PRS

Clicking on the Adjust PRS key will step the operator through the PRS-330 adjustment procedure. The procedure consists of measuring all 43 internal resistors using the DMM and storing the actual resistance values into a table. These resistance values are used in the algorithm to create the programmed resistance value. See section 8.1.4 for more information.

9.3.5 PRS-DMM Speed

There are three selections for PRS-DMM Speed. These selection affect the accuracy from the target value and time to make the measurements. Slow measurements are made with 7 ½ digits of resolution, and measurements and adjustments are made until the accuracy is better than ± 20 ppm.

Medium measurements are made with 6 ½ digits of resolution and measurements and adjustments are made until the accuracy is better than 40 ppm.

Fast measurements are made with 6 ½ digits of resolution. There are no adjustments made in fast mode. The value from the DMM is just displayed.

The uncertainty of the measurement is also displayed. The uncertainty is based upon the specifications given in the manual for the Fluke 8508A or Agilent 3458A. The uncertainty is based upon either 6 ½ or 7 ½ digits of resolution, absolute uncertainty for 365 days and a 95% confidence level.

Appendix A

SCPI COMMAND REFERENCE

SCPI is an acronym for “Standard Commands for Programmable Instruments”. For additional information or an on-line copy of this standard, see:

<http://www.scpiconsortium.org>.

The IEEE 488.2 Standard was established in 1987 to standardize message protocols and status reporting and to define a set of common commands for use on the IEEE 488 bus. IEEE 488.2 devices are supposed to receive messages in a more flexible manner than they send. A message sent from GPIB controller to GPIB device is called: PROGRAM MESSAGE. A message sent from device to controller is called: RESPONSE MESSAGE. As part of the protocol standardization the following rules were generated:

- (;) Semicolons separate messages.
- (:) Colons separate command words.
- (,) Commas separate data fields.
- <nl> Line feed and/or EOI as last character terminates a ‘program message’.
- Line feed (ASCII 10) and EOI terminates a RESPONSE MESSAGE.
- (*) Asterisk defines a IEEE 488.2 common command.
- (?) Ends a query where a reply is expected.

SCPI builds on the programming syntax of IEEE-488.2 to give the programmer the capability of handling a wide variety of instrument functions

in a common manner. This gives all instruments a common “look and feel”. SCPI commands are not case-sensitive.

The portion of commands shown in capitals denotes the abbreviated form of the keyword. Either the abbreviated or whole keyword may be used when entering a complete command. There must be a space between the command and a parameter or channel list. Multiple SCPI commands may be concatenated together as a compound command by using semicolons as command separators.

Keywords shown inside braces [] are defaults, and are optional when constructing a PROGRAM MESSAGE.

Commands not recognized have no effect on the unit’s operation and will set the corresponding bits in the Standard Event Status Register. SCPI commands that end with a question mark ‘?’ are queries. All queries should be followed by reading their response to avoid data loss.

Semicolon ‘;’ is used to separate more commands written on one line.

Note: Commands from Appendix A should not be combined with commands from Appendix B using a semicolon. These should be sent as separate lines.

Note: Multiple query commands should not be strung together with a semicolon. So SYSTEM:SVER?;SYST:HVER? Should not be combined. These should be sent as separate commands.

Terminators: For GPIB interface each command line must end with line feed <lf>. Response from the device also returns line feed <lf>.

IEEE-488.2 Common Commands

Note: Commands from Appendix A should not be combined with commands from Appendix B using a semicolon. These should be sent as separate lines.

*IDN?

Returns instrument identification “IET Labs Inc.,PRS-330,<Serial Number>,<software version>”

Serial number in the form “Ax-xxxxxxx”
x = 0 to 9. A = Alpha can be A to Z.

*ESR?

Returns the read of the event status register.

*STB?

Returns the read of the status byte register.

*ESE?

Returns the read of the event status enable register.

*SRE?

Returns the read of the service request enable register.

*ESE

Set the event status enable register value

*SRE

Set the service request enable register value

*RST

Reset the buffer

*TST?

Self test query

*CLS

Clear standard event status register

*OPC

Operation complete

*OPC?

Operation complete query

*WAIT

Wait until operation is complete before executing next command(No Function in PRS)

*PCS

Power-on Status Clear

Note: Remote command can start with or without

* symbol for compatibility.

Appendix B PRS-330 COMMON COMMANDS

Note: Commands from Appendix A should not be combined with commands from Appendix B using a semicolon. These should be sent as separate lines.

COMMON Commands:

*TST? Self-Test Returns ASCII 0 or 1, 0 = bad or 1 = good

*RST Returns PRS-330 to default “power on” condition (**NOTE:** This command cannot be combined with any other commands, it must be sent as a separate command.)

*SAV <number> Saves current resistance value into memory location 0 to 9
Number is 0 to 9

*RCL< number> Recalls resistance value from memory location 0 to 9
Number is 0 to 9

SYSTEM Commands

SYSTem:SERIal <Ax-xxxxxxx> Sets the serial number in non-volatile memory < serial number>

Serial number in the form “Ax-xxxxxxx” x = 0 to 9. A = Alpha can be A to Z.

SYSTem:SERIal? Returns Serial number

SYSTem:CONTRast <number> Sets system contrast specific number from 0 to 15

SYSTem:KEY <number> Same as pressing key on front panel of PRS-330
<Number> is 0 to 24

keys 0-9	0 – 9
OPEN	14
MENU	15
TABLE	16
Decimal Point	21
BACK	23
ENTER	24
Short	17
Open	18

SYSTem:LOCal: This command places device in the LOCAL mode and unlocks all keys

on front panel of the device. The Command is valid only for RS232, and USB interfaces.

SYSTEM:REMOte This command places device in the REMOTE mode and locks all keys. The Command is valid only for RS232, and USB interfaces.

SYSTEM:MODEL? Returns model number PRS-330 or PRS-370

SYSTEM:SVERSion? Reads system version as a string <n.nn> where n = 1 to 9

SYSTEM:HVERSion? Reads hardware version as a string <n.nn> where n = 1 to 9

SYSTEM:HIGHSPEED <0 or 1> Improves switching time to < 100 ms when set to “1”

Note: Updating the display takes significant time, so when set to “1” display updates are turned off to improve switching time.

Note: this function is not saved in memory so a power cycle will enable the display again.

Note: typical switching time is < 1 second as default or when set to “0”

Note: switching time is as well based upon the command CONFIGURE:SWITCH being set to FAST.

Setting CONFIGURE:SWITCH to OPEN or SHORT will increase overall switching time.

CALIBRATION Commands

CALIBrate:RESistance Goes into calibration mode starting at resistor 1 and then progressing to resistor 43. Each time the command CALI:RES:SET is used the resistor number is automatically incremented by 1.

CALIBrate:RESistance? Returns resistance number to be calibrated.

Numbers 1 to 43

CALIBrate:RESistance:SET <number> Sets calibrated value of resistance in ohms into memory. <number> is a floating point number representing the resistance value in ohms for the internal resistor being measured. Each time the command CALI:RES:SET is used the resistor number is automatically increments by 1.

CALIBrate:RESistance:SET? Returns the calibrated value of resistance in ohms

CALIBrate:DATE <mmddyyyy> Sets calibration date into memory

CALIBrate:DATE? Returns calibration date in format mmddyyyy

CALIBrate:HISTory:DATE <MMDDYYYY> Selects calibration date to retrieve data from

CALIBrate:HISTory:RES<number> ? Returns the resistance value based history date and

resistance <number> 1 to 43

SOURCE Commands

SOURce:DATA <display value> Sets output resistance of the PRS-330 if table is set to None or the resistance value corresponding to the display value for the table selected.

Display value in form of number and decimal point representing desired display value.

example SOURce:DATA 1.000002 would set resistance value to 1.000002 Ω if Table is set to None.

SOURce:DATA? Returns display value currently shown in the PRS display

CONFIGURE Commands General

CONFigure:SElect <2 or 4> Sets PRS-330 for 2 wire or 4 wire mode.

CONFigure:SElect ? Returns number corresponding to 2 wire or 4 wire mode.

2 = 2 wire and 4 = 4 wire

CONFigure:TERMinal <FRONT, REAR> Selects front or rear binding posts

CONFigure:TERMinal? Returns FRONT or REAR

CONFigure:SWITCh <DEFAULT, OPEN,SHORT>

CONFigure:SWITCh? Returns DEFAULT, OPEN, SHORT

CONFIGURE DMM Mode (PRS-370 Only)

CONFigure:PRSDMM:ACCURacy <SLOW, FAST> Sets resolution of DMM 7 ½ or 6 ½ respectively

CONFigure:PRSDMM:ACCURacy? Returns <SLOW, FAST>

CONFigure:PRSDMM:METER <8508A, 3458A> Sets which DMM is used

CONFigure:PRSDMM:METER? Returns string corresponding to selected DMM 8508A, 3458A

CONFigure:PRSDMM:ADDRess <1 - 30> corresponding to IEEE address 1 to 30 of DMM

CONFigure:PRSDMM:ADDRess? Returns IEEE address of for DMM <1 - 30>

CONFIGURE IEEE/Ethernet

CONFigure:IEEEAddr <number> Range 1 to 30

CONFigure:IEEEAddr? Returns <number> corresponding to IEEE address 1 to 30

SYSTem:IP <string> with format of ###.###.###.### where # is 0 to 9

SYSTem:IP? Returns IP address as a string ###.###.###.###

SYSTem:GATE <string> with format of ###.###.###.### where # is 0 to 9

SYSTem:GATE? Returns network gateway address as a string ###.###.###.###

SYSTem:MASK <string> with format of ###.###.###.### where # is 0 to 9

SYSTem:MASK? Returns network mask address as a string ###.###.###.###

SYSTem:MAC? Returns MAC address as a string

CONFIGURE Standard Values

CONFigure:STDValue <SET, STANard, DECade, RADiometric>

CONFigure:STDValue? Returns SET, STANard, DECade, RADiometric

CONFigure:STDValue:SET <number> 0.1 - 10M

CONFigure:STDValue:SET? Returns <number> 0.1 - 10M

CONFigure:STDValue:STD <1, 5, 10> EIA resistor %

CONFigure:STDValue:STD? Returns 1, 5, or 10 corresponding to EIA Resistor %

CONFigure:STDValue:DECade <number> 0.1 - 10M

CONFigure:STDValue:DECade? Returns <number> 0.1 - 10M

CONFigure:STDValue:RADiometric <number> 0.001 - 10 where number is in %

CONFigure:STDValue:RADiometric? Returns <number> 0.001% - 10%

CONFIGURE Tables

CONFigure:RTD <P100C, P100F, P1000C,P1000F>

CONFigure:RTD? Returns which RTD table is selected P100C, P100F, P1000C, or P1000F

CONFigure:TABLE:SElect <number> Selects Table to be used, <number> is 0 to 9. 0 is no table with display shown in ohms and 1 , 2, 3 and 4 are predefined and 5 to 9 are user defined tables

CONFigure:TABLE:SElect? Returns table number that is selected

CONFigure:TABLE:NAME <name> Sets Table name, <name> is ASCII up to 20 characters such as “PT100”

CONFigure:TABLE:NAME? Returns the number, 1 to 4 ,of currently selected table

CONFigure:TABLE:ERASE Erases all rows in the table

CONFigure:TABLE:ADD <user_value,resistance_value> Adds a row to the end of table showing user value and resistance value in ohms.

example CONF:TABL:ADD 20, 95 means that if the table is selected and the operator enters 20 from the front panel the output will be set to 90 Ω .

CONFigure:TABLE:ADD? Returns the last entry in the table

CONFigure:TABLE:DISPlay? Returns all data in the table

Example of information returned

PT100

20, 95

CONFigure:TABLE:UNIT <Unit> Set units for tables up to 8 ASCII characters

As an example “C” could be send for Celsius or “F” for Fahrenheit

CONFigure:TABLE:UNIT? Returns ASCII string representing the units

